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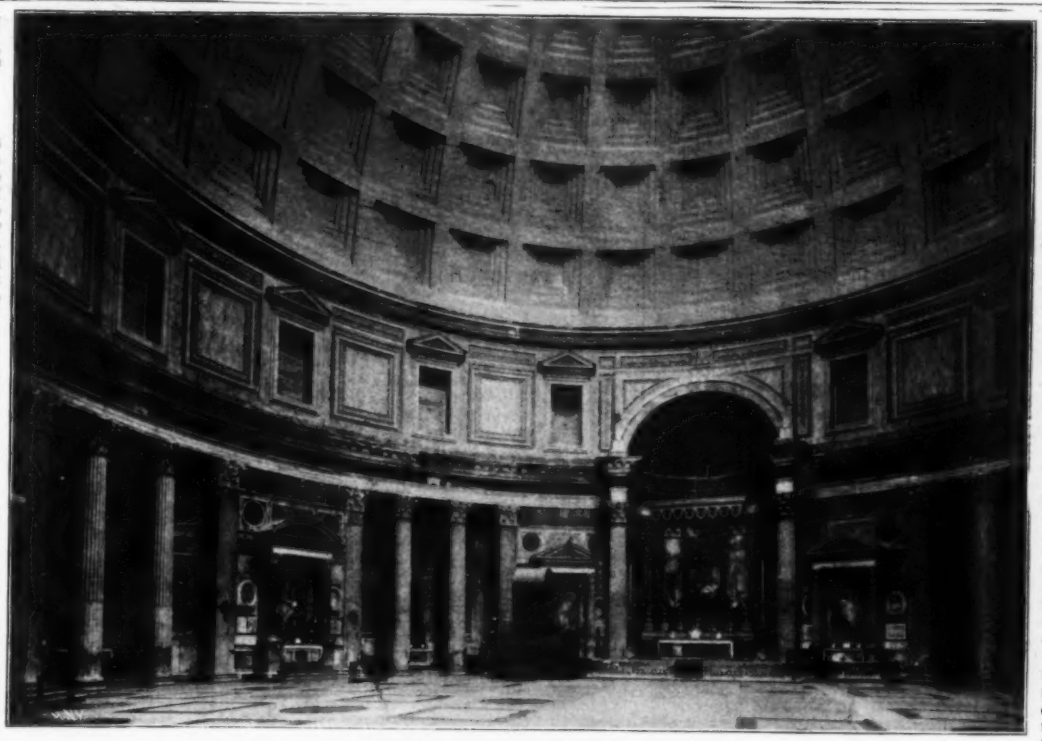
NEW RESEARCHES ON THE PANTHEON, SO CALLED, OF AGRIPPA.*

By ALFREDO MELANI.

So, the Pantheon at Rome is not the Pantheon of Agrippa, but is the Pantheon of Hadrian! But why might it not be the Pantheon of Agrippa? For a few years the architectural and archæological world has believed that the Pantheon, which no one had ever dreamed of ascribing to Hadrian, is actually due to that emperor, who lived between the years 78 and 138 of our era. The history of this monument has been made over from bottom to top. Let us see what we do know; we shall know afterward what more it will be necessary to know and the new arguments against the late researches.

The Pantheon, which has been regarded as the chef d'œuvre of Roman architecture, was built, according to old opinion, by Agrippa, in the third year of his consulate, that is to say, in the year 726 of Rome. On the frieze of the portico we see the imprints of the bronze lettters of an inscription which says: "M. AGRIPPA. L. F. COS. TERTIUM. FECIT." Dion, the celebrated historian, affirms that the Pantheon was finished in 728, and the architectonic differences between the rotunda and the portico indicate a difference of age. As a matter of fact, the Pantheon was consecrated to the "Julian gens," and dedicated, at its foundation, to the tutelary divinities of this "gens," that is to say, to Mars and Venus. The vicissitudes of the monument are sufficiently well known; it burned, with the baths, during the conflagration which took place in the time of Titus, in the year 80, and almost immediately was restored by Domitian; in the year 110, under Trajan, it was ruined by a thunderbolt, and under Hadrian it was restored, together with the baths, the Septa and the Basilica of Neptune. Afterward it was repaired under Antoninus, and in 202 Septimius Severus and Caracalla restored the Pantheon "vetustate corruptum," as is indicated in the inscription. Then it



INTERIOR OF THE PANTHEON.

EXTERIOR OF THE PANTHEON AT ROME.

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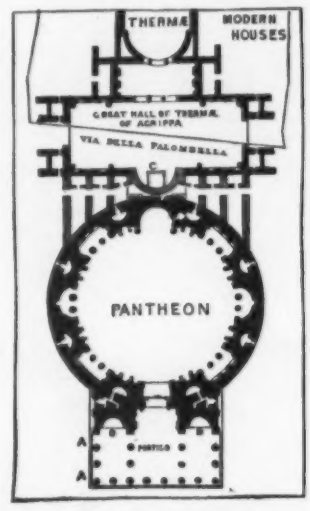
was closed, perhaps under Honorius, and devoted to civil service until the time of Boniface IV. (608–615), who consecrated it to the Christian faith, under the style and title "Santa Maria ad Martyres;" so this monument, dedicated to all the divinities, was transformed into a church dedicated to all the martyrs, while now the Pantheon is a church and a pantheon of art. In addition to the tomb of Raphael, with the celebrated distich of Bembo, it has received the mortal remains of Baldassare Peruzzi, Giovanni da Udine, Pierin del Vaga, Taddeo Zuccari, Annibale Caracci, and, last, it has received the tomb of King Victor Emmanuel. But after all this series of vicissitudes which I have mentioned, the Pantheon has at length reached our own day in a condition of perfect preservation; yet it is almost certain that if Boniface IV. had not consecrated it to the Christian faith, it would have served as a quarry for the monuments of Rome during the middle ages and the Renaissance. So it has always attracted the attention of architects and archæologists, and there does not exist any Roman monument which has caused so much agitation in the field of our studies as this same Pantheon. The chronological question concerning the circular edifice and the portico; the question of the "laconicum," built at the same time with the Pantheon; the question of the caryatides of the Athenian Diogenes—these are among the problems which have been propounded several times and never resolved in a definite fashion. One question only in the past never agitated the investigating spirit of students: the paternity of Agrippa, supported by the inscription which you know.

It is not necessary to go farther back than 1885 for the first suggestion of the exclusion, not wholly complete, however, of the conqueror at the battle of Actium. In the year named, Prof. Dressel discovered, during his investigation of the walls of the Pantheon, certain bricks marked with the stamp of the time of Hadrian, and, according to his researches, the circular edifice of the Pantheon could not date farther back than the first century of the empire, but really belonged to the age of Hadrian. Prof. Dressel's studies excited the attention of students, and, in the following year, an architect, M. H. Dell, made examinations of the monument, and his researches resulted in the same conclusion; the entire circular building of the Pantheon, according to M. Dell, was a reconstruction of the time of Hadrian. This investigation took place in 1890, and in 1891 the French architect George Chedanne, a pensionnaire of the Academy of France, at Rome, created great interest with his studies and drawings, which demonstrated—before the Court of Appeals as it were—the truth first expressed by Prof. Dressel and afterward by M. Dell.

M. Chedanne had the opportunity and the conveniences for making his investigations on a larger scale than his predecessors, having obtained the fullest support of the Italian government, who even, with the greatest impartiality, assigned certain Italian artists to assist the studies of M. Chedanne. And since I have named Chedanne, I ought, also, to mention the late Pier Olinto Armanini, an Italian pensionnaire, one of my old pupils, to whom was intrusted the drawings and reliefs of the monument, by the aid of which the architect Beltrami lately (1898) prepared the report for the Ministry, declaring the results now known. The agreement at last appeared complete, but it is complete only in appearance, for within these last few weeks the voice of a studious architect, of acknowledged authority, has been raised against Hadrian and in favor of Agrippa. And so it is that the question of the Pantheon is undecided, and will pique the curiosity of the readers of your journal. These will probably ask this question, while setting aside for the moment the problem of the circular building: Is it possible that the portico with the inscription "M. AGRIPPA . . . FECIT" is not a part of a building of Agrippa's? It is true that the reconstruction by Hadrian could not be limited to the circular structure; so the portico might be of the time of Agrippa, and might be the ancient portico of a temple. And, on the other hand, the portico might be a reconstruction. The discovery of older work beneath the actual portico gave rise to the belief that the building was really the Temple of Agrippa. This discovery relates to a very small piece of construction whose extent has the depth of the present portico and the width of about two diameters more on each side than the portico itself. Beyond this subterranean construction stretches the circular building. But the question of the portico is unsolved, all the same, that portico, I mean, which we see to-day, which might belong to an age later than Hadrian's, and might be connected with the grand works which were executed under Septimius Severus and Caracalla. The difficulty, so far as concerns the name of Agrippa as part of the inscription, as more than once pointed out, must be resolved as may be. The Roman emperors raised no obstacle to the preserving of the name of the founder of a monument to which they had made additions and restorations. We may mention Augustus, who rebuilt eighty-two temples without having inscribed on them his own name, but only that of their founders. His example might have had an imitator in Hadrian, who did not see fit ever to inscribe his own name on the monuments which he rebuilt, save in the case of the Arch of Trajan. So the present portico of the Pantheon might have been rebuilt with the fragments of an old portico of Agrippa, and that might give the explanation as regards the presence of the name.

But now let us come to the arguments against the new opinion. The architect who contradicts MM. Dressel, Dell, Chedanne, Beltrami, and all those who have agreed with them, is one of those curious students who, with the utmost modesty, from time to time bring forward ideas contrary to accepted beliefs which often are of the utmost value. This is Signor Nardini Despotti Mospignotti—the name is an exceptionally long one. Our contradictor has published a pamphlet which has just appeared, and begins by asking whether it is possible that the historian Dion, who explained the reasons for which the building was built in circular form, and pointed out the restoration executed under Hadrian—whether it is possible that he should not have spoken a single word if the reconstruction had been made ab imis fundamentis? And worse still, he always speaks of the monument in his time as if it had always been a monument of Agrippa. Could he still continue to style the Pantheon of Agrippa, and not the Pantheon of Hadrian, that which was so different from the original Pantheon? Not merely Dion, but all the later historians speak of the monument as of Agrippa. This proves that the people both before and after Hadrian had seen, and continued to see, in the Pantheon a monument of Agrippa's, and this could not have happened if in its time, under its eyes, the Pantheon of Agrippa had been destroyed and on its ruins a new monument had been constructed radically different in dimensions, configuration, style, and technical construction. Moreover, our contradictor shows that the very name of Pantheon is an argument in favor of his bold but ingenious thesis; for we ought to discover the origin of the name in the form of the monument, and not its destination. This is a false habit—that of believing that the word "pantheon" signifies a temple devoted to all the gods. It is natural that the contradictor bears with great weight on the matter of the little subterranean temple, and he speaks

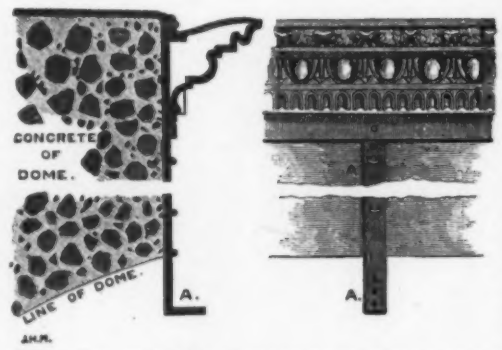


PLAN OF THE PANTHEON.

The black shows the original work. A, portico built in seventeenth century; B, niches for colossal statues; C, pedestal for statue and apse added by Hadrian.

of it as follows: "Its area occupies only about the fourth part of that occupied by the Pantheon itself, and it is not supposable that an edifice so celebrated as this was by the old writers, and named as among the most famous in Rome, could have had such diminutive dimensions, especially from the point of view of the general Roman architectonic scale." And as for the matter of the stamps of the time of Hadrian upon the bricks, he replies that they do not form obstacles to the old belief, fortified by the testimony of several writers, that Hadrian restored the monument.

Thus, the contradictor does not admit that the investigations that have been carried out by the architects and archæologists that we have mentioned are definitive. According to him, the question concerns certain attempts which do not substantially modify the ancient history and do not give indisputable authoritativeness to the new discoveries. He does not deny, however, the grave import of these stamps; but according to him, the question whether the present monument, as we see it, was built under Agrippa or under Hadrian has not yet been settled. And since he is not lacking in imagination, as well as being markedly doctrinaire, our contradictor asks whether the circular edifice of Agrippa might not have had in the first place a wooden roof. This hypothesis would explain all the vicissitudes of the monument. The present Pantheon does not present any obstacle to the hypothesis of an original wooden roof. Moreover, the



EXISTING BRONZE MOULDING AROUND THE CENTRAL OPENING IN THE DOME OF THE PANTHEON.

A A, Bronze bands to fix other parts of the lining now stripped off.

walls might have been intended, taking into account their robustness, for a masonry dome, and yet at the time of its execution the first intention might have been abandoned. The present condition of the matter does not authorize the contradictor in affirming that the present dome is that of Agrippa, but if further researches should demonstrate that it is not, then it might be sought whether the present dome was preceded by a similar dome, or by one having a different covering. In this case, the masonry dome might be due to the time of Hadrian, or not, for the answer to this part of the question must be given by the monument. And it might even happen after new studies that it should be found that Hadrian had rebuilt the roof in wood, and that the masonry dome was work of the time of Septimius Severus and Caracalla. To this supposition the Hadrian stamps, according to our contradictor, would not be contradictory, and this might explain the great resemblance of the circular edifice of the Pantheon to the calidarium of the Baths of Caracalla.

I cannot follow word for word the argument of our contradictor, and so give you simply an abstract of his ideas, which should make an impression on your readers who have kept themselves au courant with such matters.

First, then, the circular edifice and its portico are certainly of the time of Agrippa. Second, the portico itself was built in the time of Agrippa, but later than the circular building. Third, it is supposable that the present dome is as old as the original monument, yet if later studies should result in proving that the dome belongs to a later age, in this case it would be necessary to study whether the circular edifice of Agrippa could, by chance, have had a wooden roof, and in case this should be settled in the affirmative, it would be necessary to decide whether the present dome belonged to the time of Septimius Severus rather than to that of Hadrian.

THE FLORA OF THE ALPS.*

By Prof. Alfred W. Bennett, M.A., B.Sc., V.P.R.M.S.

Even to those tourists who claim no botanical knowledge, the pleasure of a visit to Switzerland is greatly increased by the extraordinary beauty and variety of its flora. Even in the lowland valleys and on the spurs of the foothills the wild plants, if not more varied and more beautiful than our own, present many novelties, at least to the dwellers in our southern counties. In the early spring the meadows are gay with the globe flower and the bird's eye primrose; later on the monkshoods, yellow and blue, the hellebores, the anemones, the phyteumas, the pinks, the gentians, the yellow foxgloves, have the charm of novelty; and the keenest delight is experienced when the blue bells of the Soldanella are first seen peering through the snow, or the Edelweiss is first gathered in its rocky home. It is only the experienced botanist who realizes that, as a compensation, some of our most beautiful wild flowers are absent from the flora of Switzerland. We can well understand the rapture with which the great Swedish botanist Linnaeus is said to have gazed for the first time on a gorse common in full bloom; for the gorse is not abundant in Central or Northern Europe. Our bell heathers hardly go east of the Rhine, and may be said to be replaced on the Swiss mountains by the "alpine roses" or rhododendrons. The wood hyacinth and the purple foxglove are not found in Switzerland.

The distribution of the alpine flora in Switzerland is very unequal. The calcareous Jura has a subalpine flora of its own. The flora of Mont Blanc and of the Alps of Savoy is a very poor one. That of the Bernese Oberland is somewhat richer. But the great wealth of the alpine flora is south of the Rhone valley; and especially in those mountain spurs and alpine valleys which stretch into the territory which is geographically and linguistically, though not politically, Italian. The Rhone valley itself exhibits a remarkable commingling of different floras. Here I have gathered, almost side by side, the subalpine hollyfern (Polystichum lonchitis) and the gigantic horsetail (Equisetum ramosissimum), representative of the Mediterranean flora.

With regard to the special characteristics of the flora of the Alps, the most familiar and most striking is the abundance of the flowers, growing either in great masses or remarkable for their large size and brightness of coloring. This is exhibited in various ways. In the first place, we may compare the alpine with the lowland species of genera which are represented in both floras—for example, Aquilegia alpina with our columbine; Dianthus alpinus or glacialis with our pinks; Scutellaria alpina with our skull cap; Bartsia alpina with our British species; Myosotis alpestris with our forget-me-nots; the Edelweiss with our cudweeds; and many others that might be mentioned. Or we may take genera that are exclusively or chiefly alpine, as far as the European flora is concerned: Gentiana, Primula, Pedicularis, Rhododendron, Soldanella, Saxifraga, Sempervivum, etc. These are among the most familiar glories of the alpine flora. Or, again, we may take genera common to high and low altitudes, but in which the alpine species are characterized by the small flowers being so crowded together as to make the masses of them very conspicuous from a distance, such as Arabis, Silene, Moehringia, Draba, and many others.

The advantage to alpine plants of the conspicuousness of the flower is obvious. Although not so dependent as lowland plants on the production of seeds for the perpetuation of the species—the great majority of them being perennials—yet, like many of our own perennial plants, trees, and others, they do, as a rule, produce abundance of ripe seeds, and for the carriage of pollen from the anthers to the stigmas they are largely dependent on the visits of insects. Now, at great altitudes winged insects are comparatively scarce, and it is obvious that a conspicuous and far-seen sign as to the locality where they can find their honey must greatly increase the number of flower visits which they can pay in the course of a sunny afternoon. Mr. G. W. Bulman has recently, in the pages of this journal,† ventured the opinion that four of the keenest sighted naturalists who ever studied the phenomena of plant physiology—Darwin, Wallace, Lubbock, and Hermann Müller—are all mistaken in their interpretation of the function of color in flowers, and that insects are attracted to flowers mainly by the sense of smell rather than by the sense of sight. My own observations, which have extended over many years, lead me to range myself unhesitatingly on the side of those distinguished names. That insects are, to a certain extent, attracted by the odor of flowers is undoubted. But in the Alps this can only come into play to a very subordinate extent. Very few alpine plants are strongly scented; and, if they were, owing to the strong winds that almost constantly prevail at those great heights, the scent would be almost useless in indicating its source to insects. In the bright color and large size or close crowding of the flowers we have, on the other

* From Natural Science.

† Natural Science, February, 1899.

hand, an obvious and admirable adaptation to this end.

But it does not by any means follow that the sole purpose of the bright color of flowers is to attract insects. We find it in flowering plants where it can have no such function, as in the scarlet stigmas of the hazel, which is unquestionably anemophilous, and in the young inflorescence of the larch; or, in Cryptogams, more especially in connection with the organs of reproduction, as in the brightly colored oogones and antheridia of Chara and the red sporanges of Sphagnum. There can be little doubt that the bright red color has an important function in absorbing and retaining the heat rays, and thus maintaining the organ at a temperature necessary for the physiological processes going on within it. Hence the very earliest of the flowers of the Alps, like Soldanellas and Hepaticas, are usually very brightly colored, and the earliest spring foliage has also very commonly a more or less bright red tint.

There are other and equally interesting characteristics of alpine plants. And here it may be worth while to contrast the conditions of life in high altitudes and in high latitudes, which are often assumed to be very similar. They are, in truth, totally different. In the arctic or subarctic zone we have a brief summer, during which there is almost perpetual insolation and a nearly uniform temperature throughout the twenty-four hours; in Switzerland the summer nights are longer than they are with us, and the difference of temperature between day and night is often excessive, the nights being associated, even in the height of summer, with exceptionally heavy dews. It will be seen, therefore, that we have totally different climatic conditions to deal with. We have in our own flora several arctic species which do not occur in Switzerland, as, for example, Saxifraga nivalis and Primula scotica.

Alpine plants have several other characteristics besides the large size or close crowding of the flowers. In the first place, although many ripen abundance of seed, but a very small proportion, as has already been mentioned, are annual. In many the floral organs are almost completely formed within the flower bud during the preceding autumn, so that they are ready to unfold with the first warm days of spring, and before the appearance of the leaves, not requiring these organs to supply them with any further food material. Hence the very early flowering of many alpine and subalpine plants, such as the hepatica, Christmas rose, winter aconite, species of Soldanella, Primula, Gentiana, etc. Secondly, from the great strain to which they are subject from violent winds, we find a considerable number with prostrate woody stems, species of willow, birch, etc., such as we seldom meet with in plants of our own climate. For the same reason the root system is also often very strongly developed in comparison with the aerial part of the plant. Furthermore, the extreme brightness of the sun during the summer months has a tendency to cause excessive transpiration or evaporation from the leaves, which has to be counteracted by specialties of structure. This protection is afforded in many ways. In some the leaves are thick and fleshy, as in species of Sempervivum, Pinguicula, etc.; or they are crowded together in dense rosettes, as in so many members of the orders Cruciferae or Caryophyllaceae. Others are covered with a dense felt of hairs, as in species of Achillea, Artemisia, or Gnaphalium, including the Edelweiss. In others again protection is afforded by the rolling back of the margin of the leaf, as in Azalea procumbens, Empetrum nigrum, etc. The greater rarity of the air at high altitudes implies, of course, a smaller supply of carbonic acid gas from which to build up the food materials of the plant. Hence the organs in which alone this manufacture of food materials can take place, the green leaves, are almost invariably strongly developed.

In a very interesting series of experiments carried on by Prof. G. Bonnier in his experiment station at Fontainebleau,* he appears to have established the fact that it is possible to produce artificially the special characters of alpine plants grown in the open air by subjecting lowland species to alternations of temperature comparable to those to which plants are subject at high altitudes. He took a number of familiar lowland plants—Trifolium repens, Teucrium scorodonia, Senecio jacobaea, Vicia sativa, Avena sativa, Hordeum vulgare—and, choosing in all cases specimens springing from the same stock, grew them in three sets: The first set was kept continually at a low temperature—4°-9° C.; the second was grown under the normal variations of temperature in Central France; while the third set was subjected to very low night temperatures, and to strong insolation during the daytime. As a rule, he found that in the third set the subterranean parts of the plant became more developed relatively to the aerial stems; the latter became shorter from an abbreviation of the internodes, more procumbent, and either more woody or more hairy; the leaves were smaller, more fleshy, or more hairy; the flowers were produced at an earlier period, and were relatively or even actually larger, and were more brightly colored. The internal structure of the leaf showed corresponding changes: The epiderm was less strongly cuticularized; the palisade tissue became relatively more important; and, in the same leaf area, the function of chlorophylous assimilation became more intense. If, as would appear from these experiments, the anatomical and morphological characters of alpine plants are the direct outcome of a response to external conditions, and if these characters are perpetuated from generation to generation, this would seem to afford strong evidence of the non-universality of Weismann's law, that acquired characters cannot be transmitted by heredity.

The number of species of which the flora of the Alps is composed varies, of course, with the view entertained by the botanist of specific limits. The late Mr. John Ball, president of the Alpine Club, the highest authority, gives the number as 2,010, divided into 523 genera, included in 96 natural orders. This is considerably richer than the flora of our islands, notwithstanding our extensive seaboard and great variety of soil and climate. A very few usually maritime plants are, however, found in Switzerland, as the thrift (Armeria vulgaris var. alpina) on lofty mountains, and the yellow horned poppy (Glaucium luteum) on the shores of Lake Neuchatel. Of these species 1117, arranged in 279 genera and 60 natural orders, belong to the upper zone of the Alps. The largest number of species occur in the orders Compositae, Leguminosae, and Gramineae, followed by the Cruciferae, Cyperaceae, and Caryophylleae, each numbering over 100 species. Both in the alpine flora in general and in that of the higher zone, the number of Compositae is nearly double that of any other order, numbering about one-eighth of the whole. Of the Saxifragaceae there are 42 species, of the Primulaceae 36, of the Gentianaceae 26.

The origin of the flora of the Alps is an interesting and somewhat complicated problem. I have already pointed out the great difference between the climatic conditions of Switzerland and those of the Arctic zone. In accordance with what might be expected from this fact, a close examination of the Swiss flora led the two highest authorities on the subject, the late M. Alphonse de Candolle and the late Mr. John Ball, to the conclusion that its nearest connection is not with the arctic flora, but with that of the mountains of Central Asia, especially with the Altai range. The arguments in favor of this view are very clearly brought out by Sir W. T. Thiselton Dyer, in his introductory note to a posthumous paper by Mr. Ball on the distribution of plants on the south side of the Alps, read before the Linnean Society on May 2, 1895, and published in its Transactions (2d ser. vol. v). According to Mr. Ball, while only 17 per cent. of the species found in the Alps are common to the arctic flora, 25 per cent. are found also on the Altai range. Still more convincing is the interesting fact that some of the most remarkable and peculiarly alpine members of the Swiss flora (genera or species) are found only on the south side of the Alps, and are distributed at wide intervals throughout a discontinuous mountain chain extending from the Pyrenees to Central Asia, while they are entirely absent from Central and Northern Switzerland and from the north of Europe. This is the case with species of Oxytropis, Primula, and Pedicularis, and especially with Campanula cenisia and its allies, and with the genus Wulfenia.

I have touched on only the more conspicuous features of the flora of the Alps. Those who have not yet turned their attention in this direction will find how much is added to their enjoyment of an alpine tour by even a slight acquaintance with its salient features.

DEUTZIA DISCOLOR PURPURASCENS.

DEUTZIA DISCOLOR PURPURASCENS.

FOR the possession of this most distinct and beautiful hardy shrub I am indebted to the kindness of the director of the Muséum de l'Histoire Naturelle at Paris, more commonly known as the Jardin des Plantes, who sent it to me some three or four years ago when still very scarce, in fact, almost unknown in European gardens. It is one of the many fine hardy plants sent to the museum garden from China by the collectors sent out by the French government, probably the Abbé Delavay. It was distributed some little time ago by the well known French nurseryman, M. Victor L. Le Moine, O.L.H., who has used it as one of the parents of his beautiful new hybrid Deutzia (gracilis being the other parent), named D. gracilis rosea and D. gracilis venusta, which he is now sending out for the first time. —W. E. Gumbleton, in The Gardeners' Chronicle.

THE EQUIPMENT OF EXPLORING PARTIES.

THE outfitting of parties for surveying or exploration in uninhabited countries is a subject hardly reducible to general rules, nevertheless, Prof. Charles H. Snow, of New York University, recently contributed to the "Transactions" of the American Institute of Mining Engineers a paper on this topic containing many interesting statements. Some of these are based on his own experience, and others are made on the authority of government reports or private explorers. The matter of food naturally receives the most attention in the paper, since it is the subject which must be considered with the greatest attention in preparing for one of these journeys. The author has collected an unusual amount of information concerning condensed food, which it is worth while to consider in this place, as such foods are frequently useful for other purposes than those of an exploring party. What is known as pemmican, which is employed to some extent in the British army, and was originally adopted by explorers who became acquainted with its properties while living with Indian tribes, is now made from round of beef, cut into strips, dried, shredded, and then mixed with beef suet and Zante currants. It much resembles the biltong of South Africa, and Prof. Snow reports that it has been employed on several expeditions with which he is acquainted; he says that it can be relied upon to remain good for long periods.

The emergency foods have recently attracted considerable attention on account of experiments made with them by the United States government. The "standard emergency ration," which has lately received considerable favorable comment, consists of dried meats, meals, and vegetables reduced to convenient form by hydraulic pressure. Three tablets of this compound with one of compressed and sweetened tea weigh 1·28 pounds and occupy 27 inches. They are placed in a can of convenient proportions, and are intended to be an entire day's allowance. The "concentrated military soup" originally prepared by M. Tanty, a French chef, for the use of the Russian army, and since employed by the government of France, has achieved quite a reputation. Beef extract is sometimes combined with partially cooked bean or pea meal, and then placed in films so as to resemble a common sausage. This mixture, known as erbwurst, is prepared in the shape of soup, only a few minutes' cooking being necessary. It was used with great success by the German army during the war of 1870. Desiccated eggs have been employed to a moderate extent, particularly with bacon and ham, and Prof. Snow says they formed one of the most satisfactory articles in the outfit of a party recently sent for scientific purposes into a very remote region and detached from its base of supplies for more than six months.

Recent experiments are reported from Germany in which sugar was permitted to form a portion of the daily allowance of a considerable number of soldiers, and it is said that the results, when compared with those obtained from men who abstained from sugar, indicated in a very marked degree its value as a food. It should never be omitted from camp supplies, save possibly in the case of emergency, and even then its superior qualities are thought to offset any disadvantage due to its greater weight than its substitute, saccharine, a material which is simply a flavor. It is well known that large quantities of sugar are demanded by the lumbermen of the northern woods, who use it on beans, pork, and other food. Prof. Snow says he passed through several consecutive days of unusual toil without much difficulty, depending principally upon crude sugar, other provisions having failed.

Evaporated vegetables are not good from a nutritive point of view, but they give variety and are useful in this respect. Dried onions are among the most reliable and dried potatoes among the least reliable. Dried fruit, as distinct from dried vegetables, should invariably be employed, particularly if the expedition is to be out for some time. Prunes, apricots, peaches, apples, and raisins have been found satisfactory from every point of view, not only as valuable food material, but as supplying one of the best means for the prevention of scurvy. White beans are universally relied on in camp diet, as their high percentage of protein renders them one of the best substitutes for meat. Hard tack must be distinguished from pilot biscuit, which is ordinarily sold as hard tack. The former is harder and less palatable, but more durable. Chocolate is a food of which the value is not appreciated in the United States, where it is regarded as a confection. It is generally easily digested in considerable quantities by those who exercise freely. It is the experience of Prof. Snow, who has invariably employed it for some years, that members of the party who at first regard it with little seriousness soon begin to depend more or less upon it. In this connection it might be said that in the Swiss Alps, mountaineering parties which are sometimes out for 48 hours in high altitudes, and have to travel as lightly as possible, frequently depend entirely on chocolate and raisins for food.

In packing the equipment, it is often convenient to divide everything, save fresh meat, into packages of about 50 pounds each. Each package may be placed in an air-tight can with the lid and seams tightly soldered. These cans should not be round, but flattened on the two opposite sides, so that they can be readily packed and carried. Matches should be included in each can, and one can only should be opened at a time. Where articles are thus divided among several packages, the contents of each one should be checked twice before it is finally enveloped, and canvas bags should be employed rather than paper for making up packages. Where provisions are to be transported on the backs of men, the packs are made by placing cans or canvas bags filled with provisions in the center of the blanket, which is then folded around the load and fastened with an ordinary pack strap.

Cotton clothing should not be employed because it is a poor protector against heat or cold. Attention can profitably be given to the subject of foot gear. The leather or top boots should not be chosen by those who are not accustomed to wearing them, as they are liable when new to cause sores on the ankles. Rubber boots can only be employed for limited periods and in fairly cool weather, and can never be worn with comfort for any extended time, particularly if the weather is hot. The unlined gum boot is to be preferred to the glazed lined boot, because of its wearing qualities and because the interior of the unlined boot can be more easily dried when occasion requires. The shoe pack, which is a kind of soled moccasin, is very serviceable, and can be procured from most of the supply stores in the West. They are ready for immediate use and are particularly good when conditions are encountered such as exist in forest lands. The German felt boot buckled above the knee and worn with a light overshoe is serviceable in cold climates. When some unknown district is to be penetrated, ordinary stout walking shoes may be selected with little risk.

Camp stoves or Dutch ovens are conveniences which should not be omitted when weight is not an object. The weight of a stove is comparatively small, while by its use the labor of preparing fuel is reduced to a

* Ann. Sci. Nat. (Botanique), vol. xx, 1895, p. 217; Comptes Rendus Acad. Sci. Paris, vol. cxxvii, 1898, p. 307.

minimum, and good fires can be made in rainy weather. Kettles are now manufactured so as to be nested one within the other; those made of copper are preferable, and they should be invariably riveted, not soldered. Aluminum cooking utensils are worth investigating.

The selection of instruments will obviously depend upon the work for which the expedition is to be conducted. Instruments are generally selected with the greatest accuracy, while the work of the party is often retarded because equal attention is not paid to the more commonplace subjects of food and clothing. In addition to special instruments for the work in hand, some others should generally be considered. Every member of the party, for example, should be provided with a small pocket compass. An aneroid barometer is generally advisable. Surveying, astronomical or similar instruments should obviously be as light and compact as possible. Combination instruments should be investigated, and a camera should always be included if possible.—Engineering Record.

[Continued from SUPPLEMENT, No. 1233, page 19763.]

ELEVATORS.*

By CHARLES R. PRATT, Montclair, N. J., Member of the Society.

THE Sprague-Pratt electric elevator was not put in actual use until September, 1891, when it was located on the fourth floor at No. 135 West Twenty-third Street, New York city, as shown in Fig. 18, and connected to the only passenger car in the building by a separate set of ropes, to enable us to change back to the old steam hoistway machine to run the car by that when we wished to lay ours off for alterations or repairs.

On May 19, 1892, at 6 A. M., a fire in the floor underneath this elevator burned the flooring from under it, dropped the plaster from above it, turned the fire hose upon it, and left it resting upon charred timbers, covered with mortar and rust. At 8 P. M. of the same day it was in operation again, carrying passengers the same as if nothing had happened to it.

It was not absolutely fireproof. The next fire in this building finished its career, but by that time we had its successor in operation in the Grand Hotel, Broadway, New York.

The following views—Figs. 19 and 21—show the general design of this elevator. In Fig. 19 the ball-bearing nut in section is shown seated in the crosshead and having its center supported by the crosshead guide shoe, the motion of the screw being transmitted through the balls to the nut, and from the nut to the crosshead, which carries the traveling sheaves.

Fig. 21 shows the single deck horizontal type; double-deck and triple-deck types are also built. The multiple-deck types are merely building independent machines one on the top of the other to save floor space. Referring to Fig. 21, the car ropes are seen leading down to the sheaves, which are carried on trunnions at left hand end of the machine, from there around the traveling sheaves, etc., until the desired multiplication is obtained, when they are anchored to an evener bar over the fixed sheaves. The usual multiplication is 8 to 1 on the machine and 2 to 1 on the counterbalance for high rise and high speed cars; four, five, or six $\frac{5}{8}$-inch ropes leading from the car over the overhead sheaves, down around a sheave on the counterbalance, up to and anchored at the top of the building; four $\frac{3}{4}$-inch ropes lead from the bottom of the counterbalance to the machine, two of them passing around eight multiplying sheaves on one side of the machine, and two on the other side, making the travel of the car sixteen times that of the nut, and the load on the nut sixteen times the unbalanced weight of the car plus its load, which sometimes amounts to 80,000 pounds.

Referring to Fig. 19, it will be noticed that there are two nuts connected together by a splined sleeve, allowing them to be forced apart by a coiled spring shown between the sleeve and ball nut. Between the conical end of the safety nut and the crosshead is a conical bronze bushing, and the end of the safety nut is shown in contact with a shoulder on the screw. This forms the upper limit of the nut's travel, at which point the car is about three feet above the top floor, and should, if the hoistway is properly designed for a high speed car, be three feet below the overlead work. If the motor continues to revolve the screw after the safety nut meets this shoulder, on account of both operator and upper limit switch failing to stop it, the nut simply revolves with the screw and turns upon its conical bronze seat in the crosshead; the friction at this point being always greater than between the nut, balls and screw, holds the nut from turning while hoisting and lowering. At the left hand end of the screw, as shown in Fig. 21, is a rubber buffer to stop the travel of the nut gradually should the lower limit switch fail to stop it. These limit switches shown on the guide beam are operated by rolls on the crosshead frame engaging a bell crank lever on the upper limit switch, and a cam keyed to the shaft of the lower limit switch and located on the opposite side of the guide beam from the switch.

Following the screw along to the right, we next observe a centrifugal governor belted to it; this operates a switch to open the brake circuit and apply the brake if the electric speed controller fails. As now built, this belt runs on the keyed taper coupling joining the screw to the armature shaft. At the time this cut was made the screw bar extended in one solid shaft through the armature to the brake pulley at the extreme right of the machine.

The thrust of the screw is located on the right-hand face of the motor bed, placing the screw load under tension. The design of this thrust bearing is shown in Fig. 25, a photograph of the caged rolls which bear between two hardened steel plates 1 inch thick by 11 inches in diameter

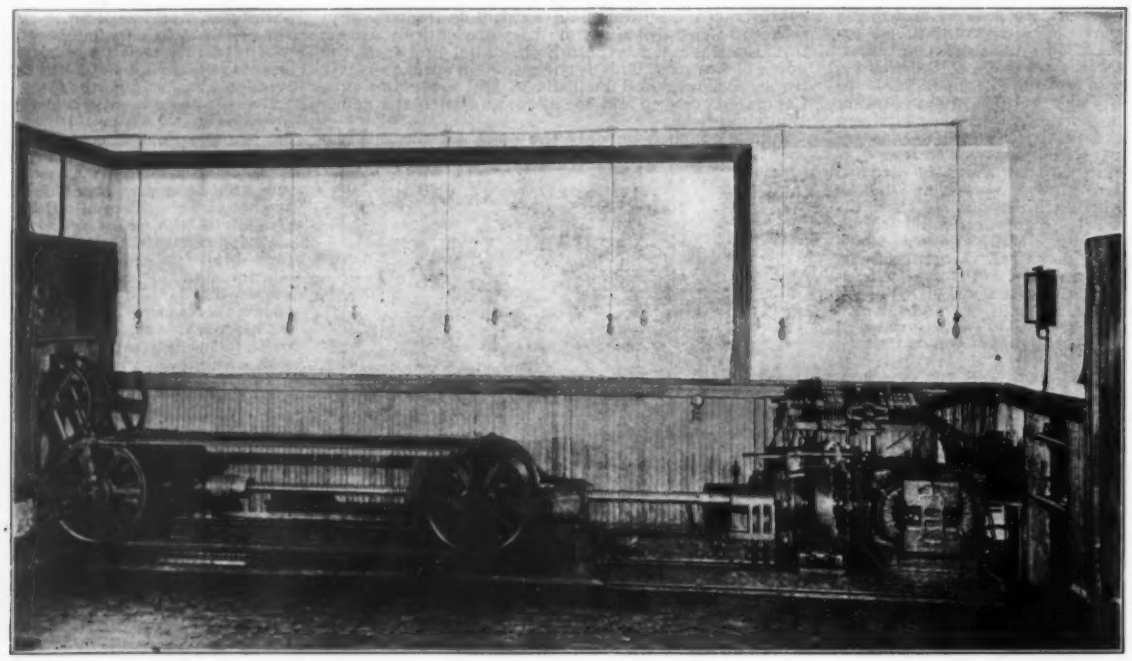


FIG. 18.

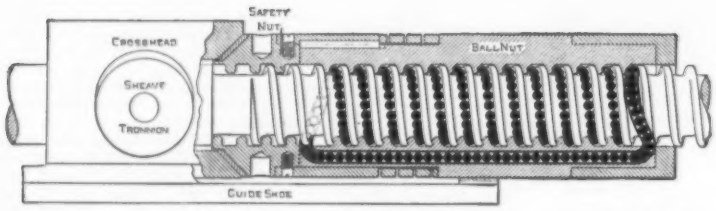


FIG. 19.—MULTIPLE SHEAVE TYPE—HOISTING NUT AT UPPER END OF SCREW.

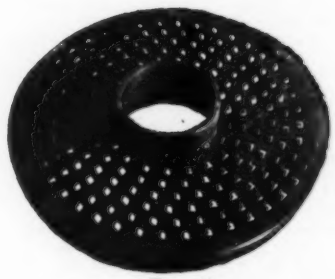


FIG. 25.

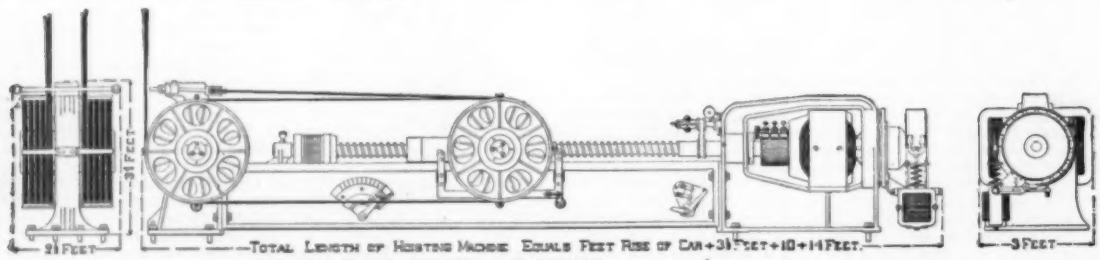

21 FEET
31 FEET
TOTAL LENGTH OF HOISTING MACHINE EQUALS FEET RISE OF CAR+31 FEET+10+14 FEET.
FOR RISES OF OVER 200 FEET TAKE ONE HALF .. .. + .. .
SPEED OF CAR WITH LBS LIVE LOAD = FEET PER MINUTE.
3 FEET

FIG. 21.—SINGLE DECK—TYPE E, 10 TO 1, 4 R.

10 to 1 = travel ratio of car to nut = 10 sheaves. 4 R signifies four hoisting ropes.

The motor is a four-pole, rectangular steel-casting field, series wound, with just enough shunt to excite its dynamo action when driven by the descending car.

The brake, as shown at the right of the side elevation and adjacent end view, is a steel band lined with wood blocks, anchored at the bottom and gripping three-fourths of the pulley. The tension is applied by a helical spring and released by a magnet, $\frac{1}{8}$-inch movement sufficing to clear the 20-inch diameter pulley.

Looking at the pulley end, the screw revolves from left to right in lowering the car, thus getting the cumulative friction tension of the band to hold the load.

The multiplying sheaves running on roller bearings places the entire transmission of power in this elevator on rolling friction, and attains the remarkable effi-

* Presented at the Washington meeting (May, 1899) of the American Society of Mechanical Engineers, and forming part of volume xx. of the Transactions.

ciency, for a machine of this character, of 70 per cent. from current delivered to motor to work done at car, giving the mechanical efficiency of over 80 per cent. This is in hoisting. In lowering, the car load on the ball nut revolves the screw, starting it instantly; the brake is released, and drives the motor connected up as a dynamo, generating 50 per cent. of the energy of the descending load in current at the dynamo's terminals. This current, being a potential varying from zero to maximum, has not been utilized as yet.

Having a rheostat in which the highest resistance will just move the car without overheating while hoisting, and hold the motor on its dynamo circuit in lowering to a scarcely perceptible speed by very low resistance, all ranges of car speed are obtained.

As stated in the early part of this paper, this elevator, as well as the hydraulic, depends upon the tension of the hoisting ropes to maintain its motion in lowering, and requires no automatic slack cable device to stop the paying out of slack cable when the car is stopped in its descent by anything but the hoisting machine. In the hydraulic, the rope tension on the piston is the only power by which it can circulate water in the vertical or discharge it in the horizontal cylinder. In this elevator, the rope tension on the nut is the only power by which it drives the screw in lowering, but the momentum of the armature continues to revolve the screw after the nut pressure is released, and if the nut was fastened to the crosshead it would be carried to the end of its travel and slack all the rope on the machine; even if not fastened to the crosshead, its inertia would carry it a long distance on the screw before it turned with it. To compensate for the momentum of the armature and inertia of the nut, the nut is not only free to turn with the screw when the crosshead pressure is released, but the spring shown in Fig. 19 jams the safety nut back against the screw's thread and, forcing the nut to turn with the screw, prevents any slack cable.

A NEW ACETYLENE GENERATOR.

ALL acetylene generators are included in one of the three following classes: 1. Where the carbide of calcium comes in contact with water, when the latter rises under it or flows in from the sides. 2. Where a regulated flow of water falls upon the carbide. 3. Where the carbide is dropped into the water. In the first class there is generally overproduction of gas; in the second elevation of temperature due to the prolonged effect of the water at one point; while in the third overproduction is avoided, but there is difficulty in getting the right proportion, or it is necessary to use carbide coated with glucose. In general these systems require more or less bulky gasometers, and the cleaning of the gas in any of them is a disagreeable and clumsy feature, while the acetylene emits an unpleasant odor.

It is principally due to the excess of water in these apparatus that the various inconveniences we have summarily indicated are attributable. The present inventors have overcome this difficulty by employing a new plan. They agitate the carbide of calcium mechanically while the water is falling upon it, and thus avoid any prolonged partial attack, and at the same time freeing the carbide of the residue which forms on its surface. Finally, the flow of water is regulated mathematically.

The new apparatus, called the "Bruncor," has the appearance of a piece of furniture. It is about as large as a small buffet and can be placed in the corner of a dining hall or in an ante-room, if the rules allow it. It has two superimposed cylinders closed hermetically by caps held in place by screw clamps. The upper cylinder contains a rotatable wire cage for the carbide; the lower one a tray to catch the residue. The feed water is in a tank beside the generator and below the carbide. A small pump raises it to the necessary level to reach the carbide, and the pipe it traverses has a siphon attachment acting as a stopper, a regulator of the flow of water, and an overflow pipe conducting any excess of liquid back to the tank.

The operating mechanism is placed in the case below the generator. It consists of a small windlass operated by a counterpoise which is wound up by hand when the apparatus is charged. This windlass rotates the wire cage containing the carbide and consequently agitates the carbide constantly, at the same time pumping in the water as it is needed. The acetylene thus generated enters a small gasometer placed beside the gas generator. This gasometer regulates automatically the operation of the entire apparatus by the movement of its bell-top, which, by means of a balanced rod and other connections, releases the windlass when the supply of gas gets low, and checks it again as soon as the flow becomes normal. The gasometer also regulates the pressure of the gas and thus the steadiness of the light.

The water tank has a gage on the outside which shows the level of the water in the tank, and from this the amount of carbide remaining unused may be roughly calculated. The water feed is regulated very

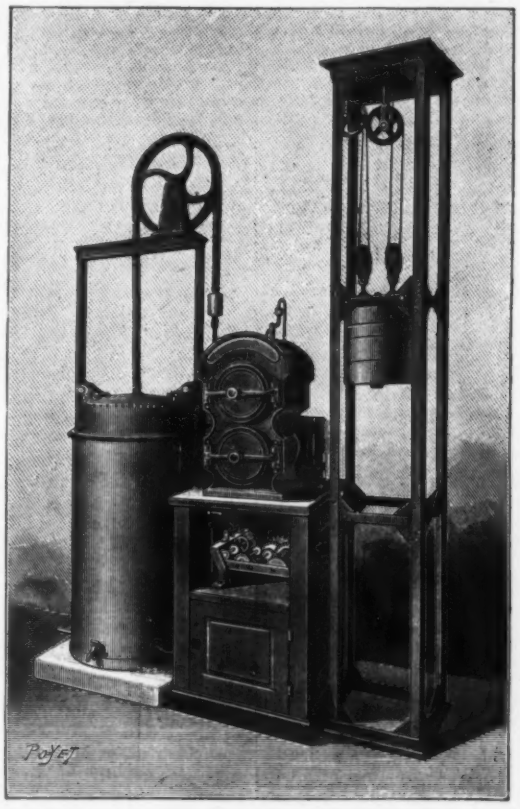


FIG. 1.—THE "BRUNCOR" ACETYLENE GENERATOR.

exactly. It is possible for the water to flow into the gas generator only when the pump operates, and the pump will not work except as the carbide is being agitated. Consequently, there is no heating, since the pieces of carbide in contact are changing their position continually. It is also impossible for any gas to be generated except when the machine is in normal operation, for the water cannot enter the carbide chamber if the motor mechanism is not working. There is no chance for over-production, since the carbide is constantly being cleaned of calcareous residue, which falls into the waste tray. A safety catch set by a key locks the mechanism when this is desired, so that, although the apparatus is fully charged, it cannot generate gas if the taps are opened by any one.

The "Bruncor" generator will work with any kind of carbide of calcium. All that is necessary to charge it is to fill the movable wire cage with carbide, and replace the residue tray in position after emptying it. The cleaning, therefore, is very easily accomplished. The odor of gas lasts scarcely three minutes. Each charge of 11 pounds furnishes almost 53 cubic feet of acetylene, which gives a light of 50 candles or 475 candle power for five hours. This is equivalent to 250 candle hours or 2,375 candle power hours. Only one burner need be lighted if desired, for the apparatus has a wide range and works equally well with fifty burners or with one. It furnishes gas to the burners at a pressure of 38·1 inches of water, a pressure which experience has proved necessary for the maximum steadiness and lighting power of the flame.

The inventors of the "Bruncor" generator have also designed a burner which they have given the same name. The tip is of opaline glass and parabolic in shape. This glass was chosen because it is not porous, and is a bad conductor of heat. The parabolic shape of the tip disperses the heat rays. The sides of the burner are thin and are quickly cooled by the inrush of fresh gas. The hole in the tip is conical in shape and its sides are very smooth, in order to do away with carbonaceous deposits. The glass tip sets in a base of cast brass which has a safety hole in its bottom. The lower end of the base piece is threaded on the outside to screw into the fixture. A leather washer is used instead of white lead for making a tight joint. This burner is valuable because it neither heats nor becomes choked. They are mounted in groups according to the intensity desired. Each of them furnishes according to its size from 7 to 17 candle power at a pressure of 38·1 inches.

Finally, this apparatus is practical. It has the advantage of working regularly without any danger, of being small in size, consequently taking up little room, of never giving off any odor, and of being so designed as to make the operations of charging and emptying both simple and easy.

We are indebted to La Nature for illustrations and description.

STRENGTH OF ALUMINUM.

METAL workers frequently ask: "What is the strength of aluminum?" The tensile, crushing and transverse strength of aluminum varies considerably with different conditions and hardness due to cold working, also to the amount of work that has been put upon the metal and character of the section, and the amount of hardening ingredients. Cast aluminum is about equal in strength to cast iron in tension, while under compression it is comparatively weak. Taking the metal 99 per cent. pure, the ultimate tensile strength per square inch in castings is 18,000 pounds; in sheet, 24,000 to 40,000; wire, 30,000 to 55,000 pounds; and bars, 28,000 to 40,000 pounds. As compared with copper, the average tensile strength of which per square inch is authoritatively stated to be as follows; Cast, 19,000 pounds; sheet, 30,000; bolts, 36,000; and wire, 16,500 pounds.

Pure aluminum compares with copper in the same manner that alloyed aluminum compares with brass. The elastic limit of 99 per cent. pure aluminum is for castings in tension, 8,500; sheet, 12,500 to 25,000; wire, 16,000 to 33,000; bars, 14,000 to 23,000 pounds per square inch.

Under transverse tests aluminum is not very rigid, although the metal will bend nearly double before breaking; while cast iron, under similar conditions, is broken very easily. The tensile strength of aluminum is greatly improved by subjecting the ingots to forging and pressing at a temperature of 600° Fahrenheit. Taking the tensile strength of pure aluminum, in relation to its weight, it is as strong as steel of 80,000 pounds per square inch. Aluminum, properly alloyed with nickel, is much stronger than the pure metal, as may be seen by the following figures: Nickel aluminum has an ultimate strength per square inch in tension, in the form of castings, of 18,000 to 28,000 pounds; in the form of sheet, of 35,000 to 50,000; and in bars, 30,000 to 45,000.

The elastic limit in tension per square inch of nickel aluminum is as follows: In castings, 8,500 to 12,000 pounds; sheet, 21,000 to 30,000; and bars, 18,500 to 25,000. The average tensile strength of brass, when cast, is 18,000 pounds per square inch; when in the form of wire, 49,000 pounds. Bronze or gun metal has an average tensile strength of 36,000 pounds per square inch.—Aluminum World.

Cherrapunji, in Assam, northeast of Calcutta, has the reputation of being the wettest place on the earth, the average annual rainfall being 493·15 inches, while it has the record of one month in which 147·17 inches fell. This year it seems bound to beat all previous records, 267·84 inches of rain having fallen between January 1 and the middle of June, five months and a half, while 73·79 inches, over six feet of water, fell in a single week.

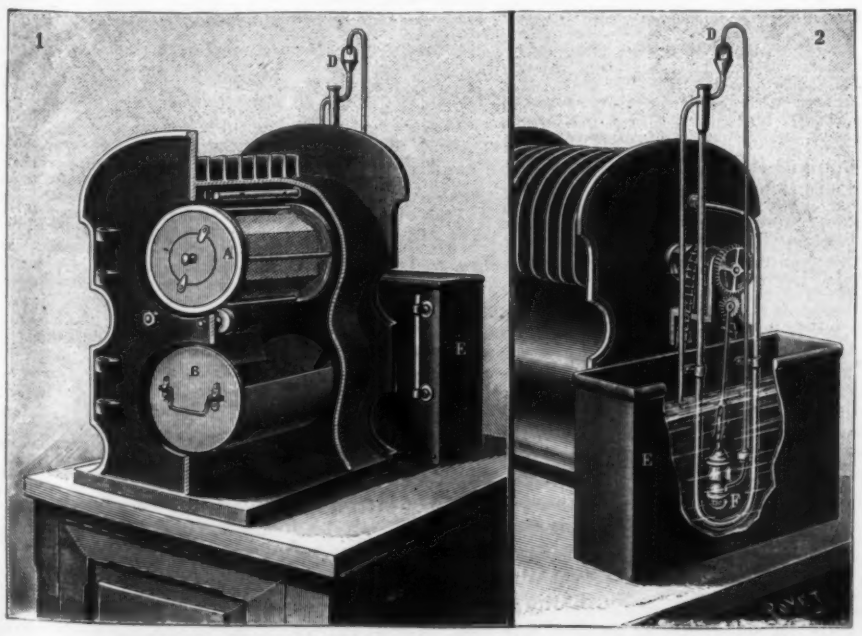


FIG. 2.—DETAILS OF APPARATUS.

No. 1.—*A*, wire cage containing carbide; *B*, residue tray; *C*, water sprinkler. No. 2.—*D*, Funnel receiving water from the pump; *E*, water tank; *F*, pump.

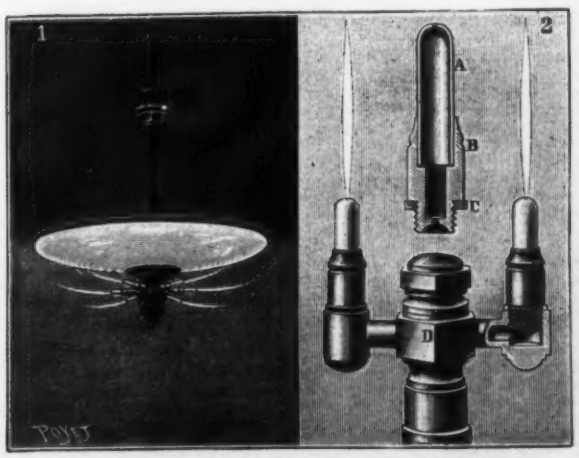


FIG. 3.

1. Six-tip burner. 2. Interior section of burner: *A*, opaline glass tip; *B*, brass base; *C*, leather washer; *D*, fixture for receiving tips.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Germany's Wool Import.—A noteworthy change in favor of South American wool has taken place in German imports within the last few years, says Louis Stern, commercial agent at Bamberg. Whereas formerly wool from the English colonies, especially Australian wool, formed the main portion of German wool imports, the Argentine Republic has taken since 1897 first rank among the countries interested in supplying this market.

The German wool imports from Great Britain consist almost exclusively of Australian and Cape wool. According to official statistics, Germany imported in 1898 about 71,000 double cwts. (15,652,660 pounds) of Australian and Cape wool, and about as much in 1897, against 970,000 double cwts. (213,846,200 pounds) in 1895. The wool imported from the Argentine Republic, including that from Belgium, which is mainly of Argentine origin, amounted to 927,000 double cwts. (204,366,420 pounds) in 1898, against 770,000 double cwts. (169,754,200 pounds) in 1897, and 750,000 double cwts. (165,345,000 pounds) in 1895. The falling off in the imports of British colonial wool is chiefly due to the decrease in the imports from Australia; the latter have, since 1895, gone down by one-third. A further decrease in the imports of wool from that country is to be expected during the next few years; for, according to a report from New South Wales, the prolonged drought has caused the colony a direct loss of about 20,000,000 sheep, and the whole production of Australian wool has, in a single year, gone down from 1,500,000 to 250,000 bales of wool.

Notes from Dawson City.—Consul McCook sends, under date of May 24, June 8, and June 20, reports in regard to conditions in Dawson City and vicinity. The city, he says, is being rapidly rebuilt after the recent fire. The following extracts are from his reports:

There is a great deal of activity in shipping at present; at one time there were seventeen steamers at the various landings. The boats are providing improved accommodations for passengers, and I do not see why excursion parties are not organized to come and see this land of gold, now that traveling is made so comfortable. I should think a trip up the Yukon would be more interesting to Americans than a trip up the Rhine.

The bulk of passenger and freight traffic will hereafter come by the upper river route, several lines of steamers connecting this port with Lake Bennett. The rates from Dawson to Puget Sound are: First class, $185; second class, $160; but these will probably be reduced one-half as the season advances. The rates charged by the companies running boats to St. Michael's, there to connect with ocean steamers, are $150 first class and $100 steerage. No second-class mail matter will be brought in or sent out for the present, as the rates are too high. No second class mail matter was received all winter, and if anyone wishes to send papers or magazines to their friends, they should mail them as first-class matter.

Instead of $20,000,000, which was reported as the probable output for this district for the past twelve months, I am informed that $10,000,000 will fully cover the product. Reports from Alaska indicate that more gold will be found there than will ever come from this territory. Alaska is rich in placer mines, but requires development. Very little prospecting was done here last winter. The miners simply ate up their grub and waited for someone else to report discoveries of gold. If the indications are good, they go on a stampede, dig a hole or two, and if they cannot find pay dirt at once, they say the creek is no good and return. This country requires indomitable pluck and energy. It is very difficult to take care of one's health, as the canned food and poor cooking are hard on the system. Typhoid fever has already broken out—six weeks earlier than last year. The ground upon which the city is built is being drained, $13,000 having been spent on this work. There are several hundred destitute persons in Dawson, who want to get out of the country and have not the means.

The city is overcrowded at present, most of the work on the mines having ceased for the season, and the gambling fraternity and saloons are reaping rich harvests. At the junction of Eldorado and Bonanza Creeks, 14 miles from here, quite a town has sprung up since last year, chiefly composed of gambling houses. All sorts and conditions of men are found in this country—doctors, lawyers, politicians—working at anything they can find to do. At one gambling table there sat recently four men, three of whom had been chiefs of police in cities of the United States, and the fourth a well-known Pinkerton detective. The authorities are now fining the gambling houses, however; and, in spite of all the drinking, etc., order prevails. Dawson is comparatively quiet and safe and the laws are enforced.

German Tool Machine Trust.—This association, which was formed in the spring of last year and comprises the majority of the works manufacturing tool machines in Germany, held its first annual meeting a short while ago in Düsseldorf, and reports for the year 1897 as follows, says Simon W. Hanauer, Vice Consul-General at Frankfort:

"Our supervisory committee has given the matter of tariff policy careful consideration, in order to be able to supply concise information to the German imperial authorities as to the productive capacity of this branch of manufacture. The declarations of the firms belonging to this trust, as well as of others outside of it, concerning the question of tariff policy have demonstrated the necessity of affording stronger protection to this industrial branch. Stringent measures are especially required in the importation of American tool machines. It is also necessary to take steps to have transportation rates to, and the tariffs of, countries in Eastern and Northern Europe reduced, so as to stimulate the export of German machines. Investigations concerning this branch show that in 1897 there were employed in 208 tool machine works (out of a total of 220 firms operating in Germany) over 26,000 hands, who received a little over 24,000,000 marks (about $5,700,000) in wages. The product of these 208 works was valued at 70,000,000 marks (almost $18,000,000), and about three-fourths of the machines produced were exported. This branch of industry is therefore important, and returns for 1898 will show further progress. Almost all the works engaged in making tool machines have undergone large extensions in the last year, and their output is consequently increased."

It will be noted that the trust asks for the putting down of customs barriers by other foreign countries and strenuously urges the putting up of such barriers against American imports, which latter are in reality the models of the German tool machines.

Electricity in Ecuador.—The following extracts are from a letter by Consul-General De Leon, dated Guayaquil, June 12, 1899, to a New York firm, to which the original has been forwarded:

There is no electric power used in Guayaquil and no demand for electrical supplies. I believe, however, that there is an excellent opening for an electric-light and street-railway service. This is a prosperous city of about 50,000 inhabitants, and with the construction of the proposed railway to Quito is bound to increase in population and wealth. It is at present lighted by gas of poor quality, which costs the municipality a considerable sum annually. A street-car system traverses almost every street, but mules, the motive power, are costly.

The finances of the municipality are in flourishing condition. The stock of the car company was at 50 in 1896. There is now a large cash reserve equal to 50 per cent. of capitalization; 15 per cent. annual dividends are declared, and the stock brings to-day $150 per share.

Fuel is scarce and expensive, but superb water power is available at some distance from the city. In 1896 the installation of an electric-light service was in progress; but the great fire, which burned eighty-three blocks of the best part of the city, destroyed the work and caused the enterprise to be abandoned. The city is almost rebuilt, with a better class of edifices, and the time seems ripe for a system combining transportation and illumination.

Machine Trade in Ecuador.—There is not a large machine trade in this country, says Perry M. De Leon, Consul-General at Guayaquil. Mr. Mann, a Scotchman, has machine works in Guayaquil; there are also a few factories, sugar refineries, and other establishments using steam appliances in this city and province, and I am informed the Ecuador Development Company (33 Wall Street, New York) is contracting for locomotives, etc., for the Guayaquil and Quito Railway.

Supplies are ordered direct, as well as through jobbers, and mostly from the United States.

There are some exceptionally good houses here in the importing business. W. R. Grace & Company, Flint, Eddy & Company, and other firms have agencies in this city.

No stock of machinery or machinery supplies worth mentioning is carried; orders are made from catalogues according to purchaser's ideas and preferences of importer, who generally selects for these orders the firm with which he is accustomed to deal. I think the local importer is the influential factor in the trade, and connection with him offers the best chance for obtaining business. At the same time, it would be well to be in touch with New York exporters.

Six months' credit is sometimes granted, but cash seems to be the rule for this class of goods. Importers generally require cash or first-class security from their customers.

A Buffalo firm keeps a representative constantly traveling in South America. He is, of course, a mechanic as well as a business man, competent to advise about purchases as well as repairs, and supervise same when necessary. In this manner, a large business is secured for this firm.

The salesman should not compete with local importers and seek orders direct, but should turn over all business to the firm with which he establishes connections. He should be of good address, able to speak Spanish fluently and able to give advice on all points—credits, packing, advertising matter, etc.

In case the business of one firm does not justify the employment of a first-class commercial traveler, it should combine with one or more houses dealing in specialties, and secure a good salesman to represent all. This plan is successfully pursued by English and German houses. The best method, in case it does not suit to send a salesman, is to appoint reliable local agents, who might be authorized to advertise in the papers of the country if they deem it advisable.

Mr. Edward Pavia, the general agent of Messrs. Flint, Eddy & Company, is a reliable and progressive man. Correspondence with him might result in mutual benefit. Local agents, however, are as a rule but a poor reliance, unless stimulated to effort by traveling salesmen.

The imports of steam machinery and appliances from the United States in the year 1898 amounted to about $40,000 gold, according to the declared values in the custom house. About $20,000 more came from Europe. This is a small amount; but Ecuador is only one of the Spanish-American countries, and a systematic effort to obtain business may be worth while. If the proposed railway to Quito* is constructed within the next few years, as expected, there will be a large increase of machinery and other imports into this country.

The two things necessary to increase our trade with this coast are competent traveling salesmen and reasonable freight rates. The Panama Railroad Line charges 47½ cents per cubic foot; Grace & Company and Flint, Eddy & Company charge 25 to 30 cents via Straits; European lines via Straits, 15 to 20 cents.

An isthmian canal is a vital necessity; only when it is constructed will we have the business we should on this coast.

Colonial Office in France.—Consul Skinner, of Marseilles, under date of June 6, 1899, says:

The Chamber of Commerce of Marseilles informs the commercial world, upon the authority of the minister for the colonies, of the organization of a colonial office. The administrators of this office hold themselves in readiness to respond to inquiries made verbally or in writing on the following points:

(1) Upon territorial concessions that are obtainable in the various French colonies, the regulations which govern the concessions, the capital necessary to exploit them, the nature of crops suitable for them, the cost of common labor, the climate—in a word, to all that concerns the exploitation of any portion of the French domain.

(2) Upon the materials and products that European France should obtain from various localities in its several colonies for its own agriculture, manufactures, or commerce.

(3) Upon the French products that should be marketable in the colonies or protectorates of France.

(4) Upon the tariffs, port charges, cost of freight by land or sea, cost of labor in connection with handling of ingoing or outgoing freight.

(5) Upon public works and enterprises of all sorts in progress or contemplated, upon quarries, mines, etc., in the colonies.

The colonial office is established at the Palais Royal, gallery of Orleans, Paris.

Leather Industry in Russia.—Consul-General Holloway sends the following from St. Petersburg, June 9, 1899:

For the purpose of encouraging the leather industry in Russia, the government has decided to place the quebracho tree—found in Chile and Mexico—on the free list.

The principal material for tanning in Russia is willow bark, which is collected in the early spring by the peasants before field labor begins; consequently, when the question of duty on tanning material is considered, the interests of the peasants are involved.

The willow bark contains but 4 per cent. of tannin, while the quebracho tree yields 20 to 24 per cent. and is necessary for the preparation of leather of a high grade. Previous to 1882 tanning material was admitted free, but during that year a duty of 4½ cents per 36 pounds was levied; this was reduced to 3½ cents per 36 pounds in 1896. Last year, a committee appointed to consider the question decided, inasmuch as quebracho wood is not raised in Russia, is a necessity, and is only used as a mixture with willow bark and other tanning material employed in the leather industry, to admit quebracho wood in logs and beams free of duty from and after February 15, 1899.

The loss of duty is estimated at $22,000 annually, and it is expected that sum will be more than replaced by the increased manufacture of leather. Russia is rich in raw skins, which are being exported to England, Germany, and Finland. These countries receive their tanning material free of duty and export leather to Russia.

Passenger Transit in Shanghai.—Consul-General Goodnow sends from Shanghai, June 3, 1899, a letter to a Chicago firm, from which the following information is extracted:

In this consular district, passenger transit on land is effected by—

(1) Rickshaws and wheelbarrows propelled by men. This is the general method.

(2) In Shanghai, most foreigners and some Chinese have horse carriages. This is limited to Shanghai, as the outside Chinese roads are not adapted to four-wheeled vehicles.

(3) From Shanghai to Woosung (14 miles) is a steam railway. The traffic is yet very light and does not require special regulations.

Transit on water is effected—

(1) By steamboats.

(2) By native junks (with sails), lorchas, and boats with oars.

All transit business is in the hands of private enterprise. The fare by rickshaw is 15 cents Mexican (7·2 cents United States) per hour; by wheelbarrow, about 7 cents Mexican (3·4 cents United States) per hour; by donkey, 90 cents Mexican (43 cents United States) per day; by steamer, about 10 cents (4·8 cents United States) per mile, including food and lodging; by rail, about 6 cents (2·9 cents United States) per mile.

Assay Offices in British Columbia.—Consul Dudley, of Vancouver, under date of June 10, 1899, writes:

The government of this province has decided to establish an assay office in this city, and has also made arrangements with the Victoria Board of Trade and bankers there for the assaying of gold at the government assay office, which has heretofore merely made assays for the benefit of the department of mines and not for private individuals. The agitation which has resulted in this action was caused by the bankers and others who objected to paying the fees asked by the United States government. The requirement of a consular fee and an entry fee were regarded as hardships.

New Mail Service with the Azores.—Under date of June 8, 1899, Consul Pickerell, of St. Michael's, reports the arrival of the steamship "Trojan Prince," with mail from America to the Azores Islands. A number of the business people of the city have expressed their appreciation of the service. The consul continues:

I trust it will not be long before arrangements can be made with the other two Portuguese lines that call here, as I am sure it will materially assist in enlarging our export business.

*See Advance Sheets No. 214 (January 3, 1899); Consular Report No. 222 (March, 1899).

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 496. August 7.—Trade on the West River of China—Textile Plants in Russia—Russian Regulations Concerning the Flax Trade—*The German vs. American Pound Weight.

No. 497. August 8.—Commercial Policy of Hungary—Manganese Mining in Bahia—Licenses for Commercial Travelers in Russia—Chinese Likin Tax on Rice.

No. 498. August 9.—Foreign Corporations in Venezuela—Measures Against the Plague at Marseilles—The Plague Situation in Egypt—Imports of Cotton Goods from Manchester—Egg Industry in Germany and Russia.

No. 499. August 10.—Trade Conditions in Indo-China—*Failure of Crops in Southern Russia—*Foundry at Monterey—Cost of Canadian Canals—Gas-Lighting Contract in Sumatra.

No. 500. August 11.—Advice to Importers of Sicilian Essential Oils.—*Petroleum Industry in Russia—Venezuelan Pearl Fisheries—German Zinc Exports to the United States—Danish Exchange Rate on New York.

No. 501. August 12.—Foreign Companies in Japan—Japanese Diplomatic and Consular Officers—Electric Railway Project in France.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Protective Varnish for Aluminum Goods.—A varnish for aluminum which is different to soda lye is prepared by dissolving 1 part of asphaltum, 1 part of colophony, and 1 part of wax in 5 parts of oil of turpentine with heat. If the action of sodium lye is not a long continued one, ordinary "zapon" varnish may be employed, or in case of emergency dull black oil varnish may be used.—Illustrirte Zeitung für Blechindustrie.

Crystallin.—Under this name a solution of pyroxylin is sold, in which the ether and alcohol are substituted by pyroligneous acid and amyl acetate, taking for 1 part pyroxylin 4 parts of methylic alcohol and 15 parts of amyl acetate. By adding 5 grammes of castor oil and 10 grammes of Canada balsam to 20 grammes of crystallin, the elastic crystallin is obtained. Same is said to possess the advantage of drying less quickly than collodion and gives a clear, transparent layer.

Beverage of Honey and Huckleberries.—Graftion gives the following receipt for the preparation of a pleasant drink from honey and huckleberries: Cause 4 kilos. of honey and 12 liters of freshly expressed huckleberry juice to ferment. The vehement fermentation lasts about 14 days. The clearly drawn off liquid is filled in bottles the following year, and is said to keep well. By the addition of suitable aromatics, fine beverages, resembling good, sweet wines, may also be obtained.—Chemiker Zeitung.

Caterpillar Lime.—Wood tar, 700 grammes; colophony, 300 grammes; black soap, 500 grammes; and fish oil, 300 grammes. Or pine resin, 5 parts; colophony, 5 parts; stearine oil, 2 parts; lard, 2 parts; Venetian turpentine, 1 part. Or black pitch, 500 grammes; thick turpentine, 250 grammes; and linseed oil, 375 grammes. Or rapeseed oil, 5 kilos, and lard, 3 kilos. Boil thoroughly, and add to this mixture, with stirring, 1 kilo of thick turpentine and 1 kilo of colophony melted together.—Neueste Erfindungen und Erfahrungen.

New Coloring of Porcelain Glaze.—From the publications of Le Chatelier and P. Chapuy, it appears that tungsten, vanadium, and molybdenum give a blue which is identical with the titanic blue. The blue from chrome, iron, manganese, thorium, and didymium resembles azurite, and, according to the metallic oxide to be colored and the composition of the flame, is of varying deepness and strength. Iron, manganese, and nickel give green colors of very peculiar tones, and cobalt green is very pure and handsome. Iron and tungsten reds are similar in tone and shade to the Chinese copper red, also the erbium red. Further studies will be published. The mentioned colorings are produced by the composition of the glaze, and according to whether the flame in the different phases of burning was oxidizing or reducing.—Sprechsaal, 1899, 32, 287.

Coffee Glazing.—The so-called glazing of roasted coffee, which dates from the time of Liebig, is intended to prevent the loss of aroma in roasting and on keeping. Hitherto sugar (2 to 10 per cent. of the weight of the berries) has been employed for this purpose, but latterly the use of resin and shellac has been proposed. Some investigators maintain that the use of sugar is prejudicial, since the acid empyreumatic vapors first given off are retained by the sugar; and, in the second phase of roasting, the faintly alkaline vapors accompanied by aromatic substances can be retained without its help by careful roasting and cooling. The authorities of the imperial laboratory for the investigation of food materials in Vienna have reported on a sample of coffee berries glazed with shellac as follows: The berries glazed with shellac preserve their aroma better than the unglazed. They possess a lacquered appearance different from coffee as ordinarily roasted. No cases are known of the employment of varnishes as preservatives. Glazing increases very slightly the weight of the roasted berries (0·575 per cent.) No difference can be detected in the flavor of the extract, but about 1·74 per cent. less is extracted from the glazed berries. From a hygienic point of view a shellac glaze is harmless, and as already mentioned, the appearance of the berries at once shows that they are artificially glazed, although it is possible that a purchaser might be misled as to the value of an inferior coffee treated in this way. The method cannot be patented in Austria, and although harmless, coffee glazed with shellac ought, in the interest of the consumer, to be described as such.—T. F. Hanausek, Zeits. f. Unters. d. Nahr- und Genussmittel, 2 (1899), 275–279.

Dammar Resin.—Dammar resin is derived from Dammara alba, Hopea splendida, H. micrantha, and Engelhardita spicata, coniferous trees indigenous to the Moluccas. It occurs in dull, powdery, colorless, or light yellow, irregular pieces, with a conchoidal fracture, which soften with the warmth of the hand; it becomes quite plastic at 75° C., and melts to a thick fluid at 100° C., and at 150° C. it is quite fluid. It is soluble in fatty and volatile oils, in chloroform, and in benzene, and partially so in alcohol and in ether. It consists of dammarylic acid, 80 per cent.; resin, 19 per cent.; and gum, about 1 per cent. It is secreted in the form of "tears," from large nodular excrescences near the roots, or on the lower portions of the trunks of the trees. In varnishes, its chief application is for pictures, since it is very clear and transparent, but does not dry so hard as copal. The so-called Australian dammar appears to be Kauri copal, derived from the Kauri pine of New Zealand. These pine trees do not grow in large numbers together, but in isolated clumps, which impart a characteristic appearance to the landscape. The largest attain a height of 30 meters and a girth of 4 to 5 meters. The resin is at first opaque and milky, but ultimately becomes amber colored. As it exudes, it collects in large masses at the foot of the tree. Large pieces of resin are not so often met with now as formerly, since the Chinese, who monopolize the trade, break them up and mix them with the clearer pieces, since the small fragments are of better appearance and are clearer and more transparent. In this way it is possible to mix off a large proportion of second-rate resin with a little of good quality. To such an extent has the adulteration of the resin by the Chinese been carried that the Batavian commercial authorities have attempted to regulate the trade, and have fixed the limit of impurity at 28 per cent.—J. O. B.—A. Zucker. Pharm. Zeit., 1899, 44 [1], 6.

MISCELLANEOUS NOTES.

The acetylene light is produced by a gas made by dropping water on broken pieces of calcium carbide. This calcium carbide is formed by electrolysis, and it may be interesting to know the energy required to produce it. The energy required per ton of the carbide is 4,260 kilowatt hours, which works out to 12·39 pounds of carbide per kilowatt per day.

A new impact testing machine for testing paving brick has been designed by Mr. G. Jones, of Geneva, N. Y., in which the bricks are held securely clamped around the inner periphery of the barrel. The barrel holds thirty-two bricks, which have one face exposed to the abrading material, which consists of 150 pounds of steel-chilled iron cubes. The chief merits of this machine are said to be (1) that it simulates actual conditions of service better than the methods heretofore used; (2) that it will probably give more uniform and more easily standardized results; and (3) that specimens of different manufacture may be readily tested at a single operation with results that are truly comparative.—The Engineer.

It is estimated that the total coal consumed in the United Kingdom in 1898 was 157 million tons, of which 76 million tons were used in the production of power for industrial purposes, 46 millions for the production of heat for industrial purposes, and 35 million tons for domestic uses. Taking the first two items in detail, it is estimated that for the production of power railways consumed 10 to 12 million tons, coasting steamers 6 to 8 millions, mines 10 to 11 millions, and factories 38 to 40 millions of tons, while in the production of heat blast furnaces used 16 to 18 millions, steel and malleable iron works 10 to 12 millions, other metallurgical works 1 to 2 millions, chemical works, potteries, and glass works 4 to 6 millions, and gas works 13 to 15 millions of tons.—The Engineer.

In a recent article in the Bulletin of the Geological Society of America, Prof. Edward Orton, of Ohio, gives a readable résumé of the geological probabilities as to petroleum, the origin of the substance and the conditions under which it occurs being set forth in an interesting manner. In accordance with the opinions of many other well-known geologists, Prof. Orton concludes that the fluid is of organic origin, derived from either animal or vegetable remains. He also argues for the importance of rock structure in determining the position of petroleum deposits, and, further, that the oil is formed in the identical stratum or rock in which it is found. In other words, and contrary to investigations made by other eminent scientists, he believes it does not migrate either up or down through the rocks.

The seaport town of Great Yarmouth, England, contains a street that may well be considered the narrowest built-up street in the world. This thoroughfare is known as "Kitty Witches" row, and measurement gives its greatest width as 56 inches. The entrance would seriously inconvenience a stout person, as there is but 29 inches of space from wall to wall. The advantages of such a pathway are not numerous; the possibility of exchanging handshakes from the window with your opposite neighbor hardly compensates for the inconvenience of his glances should you and he not be on the most friendly terms. The town contains many such streets as "Kitty Witches." They are all called "rows" instead of streets, and there are in all 145 of them, varying in their narrowness and extending over a length of seven miles. No one seems to know just why these streets exist in the form they do; some claim the inhabitants have so arranged their dwellings as to enable them to resist the attack of a possible enemy with comparative ease.—Woman's Home Companion.

The Minister of Public Instruction in Italy has recently granted permission to the Archæological Commission of Rome to make excavations and researches in the garden of the ancient church of SS. Cosma and Damiano, for the purpose of discovering other fragments of the famous marble plan of antique Rome. If the researches succeed, as is confidently expected, the Archæological Commission intends to put together the complete plan, and exhibit this interesting monument to the public. Of this ancient plan, 1,034 fragments have already been recovered; of these, 373 are to be found in the Capitoline Museum, and these form the most important part of the work. Into the walls of the staircase of the Capitoline Museum this marble plan is built, and the portions of the plan which have been found, but lost again, are supplemented from the extant drawings. This important plan was executed in the reign of Septimius Severus, and was originally placed on the Templum Sacræ Urbis, which was used as a repository for archives, municipal plans, etc. The greater part of the fragments now in the Museum were discovered behind the church of SS. Cosma and Damiano in the sixteenth century; but in the garden of that church, in 1891, twenty-five new fragments were discovered.—New York Tribune.

In the experiment stations throughout the semiarid region, much attention is being given to the investigation of excessive alkali in the soil by agents of the Department of Agriculture. In many sections, notably in California and Utah, there are large regions of irrigated land which are practically non-productive on account of the presence of alkali. Investigation makes it plain that this is due to irrigation, and in many instances to excessive irrigation. The water applied to the soil brings the salts to the surface when it rises. In some instances it has been found that the lower portion of streams had been rendered alkaline by the return of these salts in the water from the irrigated fields. The work of the experiment stations in connection with this problem is to find a remedy for the evil, and this they are seeking to do by demonstrating that in most instances crops do not require nearly so much water as is applied to them. They are working along practical lines, and the more progressive farmers are co-operating with them. Eventually they hope to be able to show just what quantity of water is required for a given crop in a given locality, and count, when able to do this, not only upon saving from destruction much land already under ditch, but also upon extending the irrigable area by demonstrating that more land can be supplied with water from the available supply than now is.

SELECTED FORMULÆ.

Prune Juice.—This is the name given by liquor blenders and rectifiers to what is practically a tincture of prunes with various added substances. The crushed prunes are extracted with diluted alcohol and the tincture or extract so formed is flavored with rose, bitter almond or other flavor, as preferred by the manufacturer. It is added to raw whiskies to render them mellow. J. N. Hurty's examination of the liquor made in 1887 showed it to have a very marked resemblance to the flavor and odor obtained by distilling pulped prunes with deodorized alcohol and water. He considered the article to be obtained by soaking prunes in a liquor composed of 80 parts of water and 20 parts of deodorized alcohol holding in solution glycerin, sugar, and possibly some glucose. It is added to raw whiskies to flavor and render them mellow. Of late years, however, the use of an artificial prune juice has come into use under the name "prune juice essence." The following is a formula for prune essence or extract:

Acetic ether	⅛	ounce.
Aldehyde	½	"
Oenanthic ether	2	drachms.
Butyric ether	1	"
Formic ether	1	"
Prune juice	3	"
Glycerin	2	ounces.
Oil bitter almond	20	mm.
Deodorized alcohol	10	ounces.

Mix and filter.—American Druggist.

For parasites of house animals the following remedy is given in Farmaceft: Cinchonine sulphate 1·0, benzoic acid 0·25, boric acid 0·5, are dissolved in 60·0 warm water; oil of bergamot, cinnamon, rosemary, and lavender, of each 0·1, are dissolved in 40·0 alcohol and the solutions mixed.—Ztsch. f. Pharm.

Rubber Cement for Cloth.—The following formulas have been recommended: 1. Caoutchouc, 5 parts; chloroform, 3 parts. Dissolve, and add gum mastic (powder) 1 part. 2. Gutta percha, 16 parts; India rubber, 4 parts; pitch, 2 parts; shellac, 1 part; linseed oil, 2 parts. Reduce the solids to small pieces, melt together with the oil and well mix.

It is also stated that the following cement for mending rubber shoes and tires will answer similar purposes:

Caoutchouc in shavings	10
Resin	4
Gum turpentine	40
Oil turpentine	enough

Melt together first the caoutchouc and resin, then add the gum turpentine, and when all is liquefied, add enough of oil of turpentine to preserve it liquid. A second solution is prepared by dissolving together—

Caoutchouc	10
Chloroform	280

For use these two solutions are mixed. First wash the hole in the rubber shoe over with the cement, then a piece of linen dipped in it is placed over it; as soon as the linen adheres to the sole, the cement is then applied as thickly as required.—Pharmaceutical Era.

Appetite Pills for Dogs.—

Calamus,		
Dried sodium sulphate, of each	6	grammes.
Sodium bicarbonate,		
Powdered rhubarb, of each	2	"

Mix and form into six pills, with sirup. Give one pill twice daily.—Pharmaceutical Era.

Perfumed Bath Powder.—

1. Sodium bicarbonate	4	ounces.
Sodium biborate	4	"
Eosin, a sufficient quantity.		
Oil bergamot	1	drachm.
Oil neroli	20	minims.
Oil rosemary	20	"
2. Powdered borax	4	ounces.
Salicylic acid	60	grains.
Essence of cassie	1	drachm.
Essence of jasmine	1	"
Oil of lavender flowers	20	drops.

Rub the oil and extract with the borax and salicylic acid until the alcohol is evaporated. Use a heaping teaspoonful to the body bath.

EFFERVESCENT POWDER.

3. Tartaric acid	10	ounces.
Sodium bicarbonate	9	"
Rice flour	6	"

A few spoonfuls of this powder when stirred into a bath-tub full of water causes a liberation of carbon dioxide, which is thought by some to be "refreshing." The powder may be perfumed by the addition of suitable essential oils.

BATH TABLETS.

Under this heading an English exchange gives the following formula:

4. Concentrated crystal soda	4	ounces.
Tartaric acid	1½	"
Orris root	½	"
Oil of lemon	½	drachm.
Oil of orris (or ionone)	5	minims.
Oil of ylang ylang	5	"

Mix the whole thoroughly. Make into a stiff paste with strong alcohol, and form into suitable sized tablets, which dry. The concentrated crystal soda or crystal carbonate is supposed to soften the water in which it is used.—The Pharmaceutical Era.

Library Paste for the Trade.—The following formula is offered as producing an excellent and permanent product:

White dextrin	5 or 5½ pounds.
Water, heated to about 160°	1 gallon.
Oil of wintergreen	½ drachm.
Oil of cloves	½ "

Dissolve the dextrin in water by stirring; when cool add the oils and stir; pour the product into bottles, cork, and put in a cool place where the paste may congeal and ripen. The time required for this varies, but the process can be much expedited by placing the bottles containing the paste in a cooling chamber at a temperature of 40° to 45°, when it will ripen in a few days.—Bulletin of Pharmacy.

GERMANY'S NEW POSSESSIONS IN THE SOUTH SEA.

According to the agreement made between the German and Spanish governments on February 12 of the current year, Spain, for the sum of 25,000,000 pesetas, cedes to Germany the Carolines, together with the Palau and Mariana Islands, with the exception of Guam. Germany agrees to grant the same concessions to Spanish trade and Spanish economical undertakings in the Caroline, Palau and the Mariana Islands as to German trade. Spanish religious orders are to be given the same rights and privileges as German orders. Spain is to establish a naval and commercial coaling-station in the Caroline archipelago, as well as in the Palau and Mariana archipelagoes. The treaty is to be ratified as soon as possible by the bodies politic of the respective countries.

As the German Minister of Foreign Affairs, von Bülow, informed the Reichstag on June 6, an agreement was also made with respect to the tariff, which agreement has been approved by both sides. A commercial treaty had existed between Germany and Spain up to February 1, 1893. On this date a proviso went into force which in May, 1894, led to an open tariff war that lasted until July, 1896. These deplorable commercial relations between the two countries are now happily at end; although Germany retains the privilege of regulating her commerce as she may see fit after 1903.

Hardly had the United States declared their intention of taking possession of the Philippines, when the German government took the necessary steps to bring the entire Spanish possessions in Micronesia under the German flag. In order to acquaint itself better with the conditions in Micronesia, the German government dispatched the cruiser "Arcona" in July, 1898, from Kiao-chau to the Mariana Islands. Here the German vessel entered the chief harbors, and then proceeded to the Carolines, among which she cruised for several weeks. Finally, she visited the Palau Islands and the Philippines, and on October 16 left Manila on her home voyage. In the meanwhile negotiations had been begun, during which no slight difficulties were encountered. Spain originally demanded 40,000,000 pesetas. Then England assumed a rather unfriendly attitude in the Samoan question; and the United States seemed to side with her. But the German government tenaciously clung to its original intention; the United States in later negotiations were more favorably inclined; and Spain moderated her demands.

Economically at least the Spanish islands in Oceanica have formed part of Germany's interests; for the German Jaluit Company controls almost the entire trade of the islands. Hitherto the produce of the plantations has been moderate; because the Jaluit Company felt no inclination to invest large capital while the tottering government of Spain still ruled the islands. The chief product of the new German possessions is copra, although all tropical fruits can be grown. The coffee and cacao of Ponape are excellent; the former is even said to be equal to that of the Philippines.

NATIVES OF PONAPE.

The plants which serve as food for the aborigines are bananas, yams, taro, bread-fruit, melons, figs, ananas, betel-nut, and the pepper plant, from which the beverage "kava" is prepared.

MALE ABORIGINES OF RUK ISLANDS.

MAN AND WIFE ON YAP ISLAND.

A NATIVE HUT ON YAP ISLAND, SHOWING STONE MONEY LEANING AGAINST THE RIGHT WALL.

The natives, whose religion was originally ancestor-worship, have become partly converted to Christianity. On the Mariana Islands a Catholic mission has been erected; while on Kusaie (Ualan) a Boston Baptist mission has its South Sea headquarters. The American mission has stations on Ruk, Kusaie, Ponape, Mokil and on Mortlock Islands.

Our illustrations present scenes from the larger Caroline Islands, Yap, Ponape, and Kusaie, all three of which are of volcanic origin.

Yap is an island 129 square miles in area, with a good harbor. The inhabitants are skilful boat builders, sailors, and good tradesmen.

Ponape has an area of 215 square miles and is covered with dense jungles consisting partly of conifers—an excellent material for house and boat building. The island has a magnificent harbor and has long served as a stopping place for whalers, and as a supply station for trepang and tortoise shell. The natives here and there have accustomed themselves to European dress and from time immemorial have practiced weaving, an art seldom met with in the South Sea Islands.

Kusaie or Ualan, with an area of 70 miles, has the harbor at Chabrol. There are mountains on the island 2,130 feet in height.

Although Spain in 1890 found it necessary, with great bloodshed, to suppress an uprising on Ponape, the islanders, nevertheless, as a general rule are confiding, open, and hearty.—Illustrirte Zeitung.

RELIEF MAP CONSTRUCTION.*

By Frank G. White.

If a relief map of a certain plat of ground is desired, generally the first thing to be obtained is a good contour map. One method which does not require this will be referred to later. If the area is small and is to be platted to a large scale, rather a careful survey should be made. A convenient method for a small area is to lay it out in one hundred foot squares and take levels at each corner of each square.

If a large area is to be mapped, a quicker method of

* From "Proceedings of the Iowa Engineering Society," January, 1899.

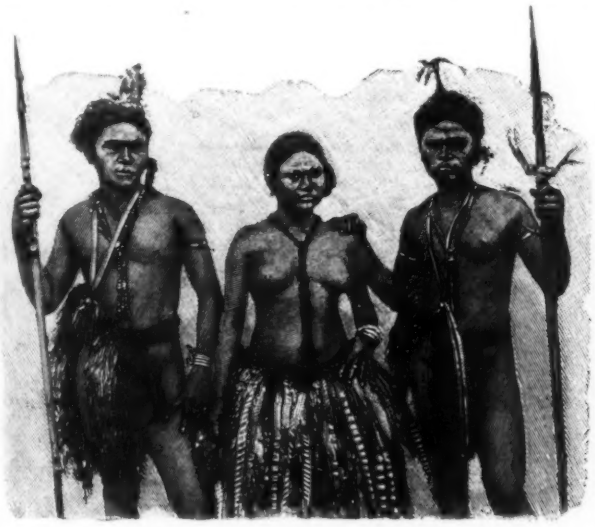
making the survey must be used. Base lines may be laid out, levels taken at points where there is a decided change of grade, and measurements taken from these points perpendicularly to a base line, the plus to the point of intersection being measured at the same time. Or the rod may be set to give the proper elevations and points on the contours found by trial, measurements to base lines being taken as before.

The proportions between the vertical and horizontal scales usually used are from 1 : 1 or 2 : 3 for gently undulating ground on a large scale to 1 : 10 or even greater for country on a very small scale. If the country is mountainous, the exaggeration required will, of course, be less.

There are several methods of constructing models, all differing materially. Perhaps the one most used is the method of building up on the contours. A tracing is made of each contour, and these tracings are pasted on sheets of cardboard, metal or thin boards, the thickness of which will be equal to the contour interval on the scale chosen. These are then sawed out by a scroll or band saw and arranged in order on a suitable base. The model is then in the form of a series of steps or terraces, the surface of each representing the level of the corresponding contour. These steps are then filled with some plastic material and the whole painted and finished off as the modeler desires.

If the map is to be made all of boards, or cardboards, as the case may be, a slightly different course is pursued. When the contours are laid down on the base, each is elevated one contour interval from the corresponding contour in the case just cited. Thus a series of steps are produced, the angles of which must be carved off instead of being filled in. A model of this kind has the advantage of being all of one material, so that there are no plastic substances to set and shrink away from the wood. On the other hand, it is more difficult of construction, only an experienced carver being able to produce easy, graceful curves.

A method fundamentally different from the ones described is used when the entire model is to be filled with a plastic substance. Parallel lines are drawn across the contour map, and upon strips of paper profiles of these lines taken from the contours are platted. These profiles are then pasted upon strips of wood or tin and the strips are sawed along the lines. They are then tacked in position on a base as before, similar profiles of the boundaries of the tract, and if necessary cross-profiles, are constructed and tacked in place. The boxes thus formed are then filled, and the top is smoothed and dressed off by resting a straight edge upon the profiles and drawing it across the model. It will be seen that in this method no contour map is necessary, as the elevations of the line, the profile of which is to be made, may be taken and platted directly.



PLANTER AND NATIVE LABORERS.

A method closely resembling this was suggested by Mr. Gaylord Weeks, of the present senior class of the University of Iowa, and tried in the laboratory. A careful tracing of a contour map was made and tacked on the base intended for the model. Tin strips of different widths were cut, the difference in each case being equal to the contour interval to the reduced scale. Wire finishing nails were then driven into the base on the contour lines, and the strips of tin woven in and out around the nails. The spaces were then filled and the surface smoothed off by allowing the straight edge to rest on the tin strips while being used as a scraper.

NATIVES OF YAP ISLAND.

The substances which are used as a filling for relief maps seem to be very few in number. Paper pulp has been used to some extent, the great objection to it being that it absorbs moisture very readily. It is, however, very easy to handle, and if the surface were well shellacked this difficulty would no doubt be obviated. In a paper on this subject by Mr. O. B. Harden, which was published in vol. x. of the "Trans. of the Am. Soc. Mining Engineers," the author gives the following compound as suitable for work of this kind: Yellow beeswax, 16 parts; cornstarch, 8 parts; Venetian red, 1 part; Venice turpentine, 4 parts; sweet oil, 1 part. The wax must be soft and plastic, but tough and not sticky. Mr. Harden also states that clay may be used to some advantage.

A mixture which was tried here in the laboratory was composed of 3 parts Portland cement, 1 part flour and just a little cornstarch, about 2 or 3 ounces in 5 pounds. This seemed to work very well, the greatest trouble being on account of the shrinkage when dry. When mixed with the proper amount of water, it had about the consistency of putty and was easily smoothed

A GROUP OF NATIVES ON YAP ISLAND.

if the trowel was kept continually wet. This mixture did not seem to set, but simply dried out, and could be worked again by moistening the surface. After drying out thoroughly it could be dressed off with sandpaper.

For reproducing the models, plaster of Paris is used. The map is first coated with soap suds to keep the plaster from sticking, and an impression is made. From this negative any number of models of plaster may be made by simply taking a cast.

THE TRANS-SIBERIAN RAILROAD.*

By Henry Michelsen, Secretary National Irrigation Congress.

The results of the operations of the Trans-Siberian Railroad for the year 1898 are said to be encouraging to the Russian government. In its present unfinished state the traffic must be strictly local. An analysis of the government report shows that the country through which the line runs, though at present undeveloped and subject to the rigors of the climate on a prairie sloping to the Arctic Sea under the fifty-first degree of latitude, is still capable of producing great crops of grain; that it has fine forest resources, that live stock may flourish in it, and that coal has been found sufficient for the purposes of the railway and the population which may settle on the lands contiguous to it. Therefore, the railway may be expected, when finished, to become a factor in the commercial business of the world, even if its through traffic is not considered, by the opening up of the natural riches of the hitherto unknown continent which it is destined to make accessible.

The length of the road with its projected extensions is so great that even Americans, who are accustomed to deal with large distances, will have some difficulty in comprehending the scope of this undertaking. The longest continuous line on the North American continent is the Canadian Pacific Railway. Its main line from Montreal to Victoria is 2,990 miles in length. The located line of the Siberian Railway, from Cheljabinsk to Vladivostock, is 4,776 miles; the branch through the recently acquired territory of Manchuria to Port Arthur will be 1,273 miles; so that the system will commence, before any feeders are built, with 6,000 miles of track. The distance from Vladivostock to St. Petersburg will be nearly 6,700 miles. The distance from Port Arthur to the harbors of the North Sea, on the estuaries of which the European trade with Eastern Asia is centered, is, approximately, 6,900 miles by the nearest route.

The Siberian Railway is, like all Russian roads, of a five-foot gage. It is constructed after the manner of American Western railways, single-tracked, gravel-ballasted, where ballasted at all, with Howe truss bridges over the smaller waterways, and steel bridges across the large rivers. The watershed of the country east of the Ural Mountains is from south to north for more than 3,000 miles, which means a northern exposure entailing more severity of climate than is known on the railways of the United States and Canada. The rivers here are deep, full flowing streams, the alluvial bottoms of which necessitate large spans and make it desirable to have as few bridge piers as possible. Floating ice is in the rivers for about seven months of the year. The bridge at the Ishim has openings amounting to 700 feet, that at the Tobal 1,400 feet, that at the Irtish 2,100 feet; and the bridge over the Yenesei has a total length of just under 3,000 feet. Lake Baikal is traversed by a steam ferry for a distance of some forty miles. Forty bridges, each over 200 feet long, cross the tributaries of the Obi River between Omsk and Irkutsk. East of Baikal the road passes into the valley of the Amoor River, bridging waterways running from north to south. After spanning the Amoor at Khabarovka by a steel bridge some 5,000 feet in length, it turns abruptly to the south toward Vladivostock, running to the east of the rivers skirting the Khenden-a-Lin Mountains. The total length of water crossings between Cheljabinsk and Vladivostock is given at 30·1 miles exclusive of the 40 miles of ferry; the snow sheds and fences at 565 miles.

The western section extends from Cheljabinsk on the European frontier to Pochitanka, 1,080 miles. It runs for 880 miles over a highland plain so level that the distance exceeds an air line by only 2½ per cent. There are tangents on this division of 50, 62, and 86 miles. For fully 600 miles the line traverses an excellent agricultural country, producing all kinds of grain in abundance. The 300 miles west of Tomsk run through a fine stock country containing many small lakes of slightly brackish or alkaline water; two hundred miles east of the main stream of the Obi River the country is hilly, heavily timbered, and cut up by many small streams. The central division commences at Tomsk and extends to Irkutsk, through a barren upland, climate and soil alike forbidding settlement. The third section crosses the Baikal Lake, and extends to Misorskaia. From this point to the Amoor section, the road passes its summit to drop down into the Pacific slope, running along the old Chinese frontier, touching Kiahta—the emporium of Russo-Chinese overland trade—through a country rich in gold, silver, copper and iron, producing even now, with antiquated machinery, some fifteen millions of dollars worth of gold annually. The Amoor section extends eastward toward the Pacific, approximately 1,600 miles. This is the district from which the greatest returns may be expected agriculturally. It is well timbered, contains large bodies of alluvial lands and its climate is tempered by the proximity of the Pacific Ocean. The next, the Ossoori section, extending southward to the terminus at Vladivostock, runs through a hilly country fit for agricultural and stock raising purposes, and rich in excellent bituminous coal. The branch which runs through Manchuria passes through a thickly settled farming country; it leaves the Khingan Mountains to the west and crosses the many streams flowing into the Soongaree River, reaching the fine harbor of Port Arthur, which, being ice free the year around, will, it is safe to say, rival Hong-Kong at no distant day. Port Arthur is destined to become the great city of Siberia.

The fertile territory tributary to the Siberian Railway proper is equal in size to Germany, Austria, Belgium, the Netherlands, and Denmark combined. This territory is capable, if once peopled, of sustaining a railroad out of the local traffic it will produce. The long stretch of 1,500 miles extending from Tomsk to the head waters of the Amoor is perhaps the only distance on the line of the road which a Western railway man would consider difficult to handle successfully as regards revenue. But this upland country has not been explored, and there is a possibility of its becoming a mining country of great importance.

Were it possible to impart to the Russian peasant the industry and sobriety of the American agriculturist and the latter's knowledge of intense and diversified farming, the next five years might here see the commencement of a revolution in the production and distribution of the world's grain products by the hands of Russian men. But many causes combine to retard the progress of Russian agriculture. The ignorance of the mujiks as to rotation of crops, and their unwillingness to save and use fertilizers, the Mir system, which makes the tenure of land problematical, the lack of proper transportation facilities, which hinders the distribution of harvests, are all important factors to this end. There is also a lack of population. In European Russia the average is only 42 to the mile; in Siberia there were, according to the census of 1890, 4,095,535 inhabitants on 4,824,540 square miles. To open up Siberia properly, it will therefore be necessary to bring population from outside of the empire. Fortunately, this will not be difficult to do.

Americans are apt to underestimate the problem which the Russian government has to face. The government of the United States is the exponent of the moral and physical standard of its people; the Russian government has for centuries tried to lift its people to a higher plane of civilization. Since the days of the Romans there has not been a government endowed with so much knowledge of managing uncivilized peoples as that of the Muscovite Czars, from Ivan to Nicholas. The art of government never has been and never can be judged by the same rules, so long as each separate nation shall retain its individuality, and that must be considered the most perfect administration which enables the greatest number of its subjects to live in the peaceable and profitable employment of the faculties with which they are endowed. Parliamentary government may suit Englishmen and Americans; but Englishmen do not believe it fit for the Hindoo, and Americans may not introduce it into their new possessions; they certainly have not tried it with their Indian tribes. Mexico's people were of little account when under a government copied after that of the United States, but the country has been thriving under the thinly disguised despotism of its present able ruler. The conviction of the Russian people is, that their government is meant for universal dominion. It must be admitted that not only has there been within their Asiatic provinces a vast progress of civilization and a betterment as to the physical status of subject races, but a contentment has been engendered comparable only to that existing in the provinces during the best days of the Roman empire. Wherever Russia's flag has been planted in the East, prosperity has been created and material progress has been rapid. Agriculture will expand in Southern Siberia, as it has in the country between the Black Sea and the Caspian since its conquest; Bokhara and Samarkand are hives of industry once more; the Trans-Caspian Railroad finds itself unable to transport the cotton crop of irrigated desert, raised in places where the culture of it was unknown but a decade ago. Russia is in much the same position as the United States; with a great industrial and commercial future, it is a new country, being developed by a practical and go-ahead people. Its form of government is no obstacle to material progress; in 1800 the ordinary receipts of the imperial treasury were but sixty-seven millions of rubles; in 1898 they amounted to considerably over one thousand millions. What an enlightened autocratic government may do with a people willing to obey and learn, if time be given it for the accomplishment of its educational purposes, is not easily forecast; that this one will do much cannot be doubted.

The Trans-Siberian Railroad must not be considered as designed for the same purpose only for which the American transcontinental lines were built. Our Western railroads were built by associations of capitalists, with government aid in money and lands, but they were meant by their owners to be investments for their own behalf. That the lands were settled, and thereby became of taxable value to the government, was a matter of secondary consideration to the owners of the roads; and the government exacted repayment of the capital advanced when its loans became due. The results have been proportionate; the arid West is still arid, although it would have been easy enough to plant into it twice the population it contains had irrigation been a part of the scheme of government improvement.

The Siberian road is built by the imperial government for its own purposes, military and colonial, and will, very likely, remain under its immediate control. The expenditure originally authorized was two hundred millions of dollars; it is probable that another hundred millions may be added for branch lines through the newly acquired territory south of the old frontier.

Whether the road will pay as an investment, remains to be seen. If it does not, its cost will still be but a small addition to the national debt, which amounted, according to the Zeitschrift für das gesammte Actienwesen, at the close of 1898, to but 7,900,000,000 of marks—not quite $2,000,000,000. This is but a trifling indebtedness, compared with the present revenue of the empire, and it is more insignificant when the resources of the government are thought of and the fact is considered that it has been spent in part for most valuable and revenue-creating public improvements belonging to the nation. The area of European and Asiatic Russia combined amounts to more than 10,000,000 of square miles.

The transportation problem of the Trans-Siberian Railway is a peculiar one. The products which it may expect to carry are what Americans would call low grade freight—grain, ore, live stock, and timber. To transport these articles from the interior of Asia to the markets of the world must entail too long a railroad haul. It may be pointed out that California wheat is carried from San Francisco to Liverpool via Cape Horn, not all rail by way of New York. In general it may be held that agricultural staples cannot stand a railroad haul of over 2,500 miles. The greater part of the import and export trade of Eastern Asia is in the hands of the western European nations, taking its way through the Suez Canal. The schedule time of the North German Lloyd's steamers between Bremen and Shanghai is 46 days. Its tariff rates are less than $6 per ton or cubic meter of room to Shanghai or Port Arthur, $6.25 to $8.75 to Yokohama and Hiogo, and $8.75 to $11.87½ to Nagasaki. Between London, Liverpool, and other English harbors and Asiatic points, the freights are a little less than is charged to and from German ports. This means, practically, that in the competition for through freights, the Trans-Siberian Railway may not cope with the steamship lines to Europe, either in rates or time. For, assuming the adoption of the European classification, with its tariffs running from 0·47 to 2·35 cents per 1,000 kilogrammes per kilometer, we have a rate per ton of the lowest grade of freight for 7,000 miles of over $200, which is prohibitory. As to time, we must consider the necessity of a transfer from the Russian five-foot gage cars to the standard gage cars at the European frontier, and also the physical condition of Russian railways in general. Railroad men will concede that on crowded, single-track Asiatic railways a freight train will do well if it makes 240 kilometers, or 150 miles, a day, for many consecutive days, taking into consideration the liability to accidents, delays by reason of accumulated traffic from opposite directions, and the uncertainties incident to an Arctic climate. At any rate, this is the standard adopted by other Russian roads, of which Mr. Poultney Bigelow says that "an express train means a train that does not carry cattle and occasionally attains a speed of 25 miles an hour," and where the adaptability of the inferior administrative officials to the requirements of modern railway service has not, as yet, been demonstrated. The time, therefore, between Vladivostock and Hamburg, under present conditions, will be about the same either by rail or steamer, with the advantage of uninterrupted passage and fragmentary rates in favor of the latter. For east bound freights from the interior of Asia to the United States or Canada there will be but little demand. Siberia, Canada, and the States of the Union raise products of the same kind, making an interchange unlikely to occur. We are therefore bound to assume that if the Siberian Railway is to earn its expenses at all, it must rely upon its local traffic almost exclusively. This can only be made possible by the introduction and establishment of a new population, both agricultural and manufacturing, originating beyond the old limits of the empire into the territory traversed by the road. Now this population is close at hand. It does not have to cross broad seas, as did the immigrants that built up the United States. The time is big with events in the Far East. The close of the century witnesses the breaking up of the greatest of old world industrial nations, the empire of China, and Russia will fall heir to whatever it may choose to take, both as to Chinese population and territory. So far from imitating American anti-Chinese legislation, Russia favors the immigration of its newly acquired subjects into the Siberian provinces.

The "spheres of interest" in China, at present, stand thus:

ITALY.			
Tokien and Che Kiang			72,630 square miles.
GERMANY.			
Shantung			65,104 square miles.
FRANCE.			
Kwang Se	78,250	square miles.	
Kwang Tung	79,456	" "	
Quei Chow	64,554	" "	
Yunnan	107,969	" "	330,229 square miles.
GREAT BRITAIN.			
Kiang Su	44,500	square miles.	
Kiang Se	72,176	" "	
Ngan Hoe	48,461	" "	
Honan	74,320	" "	
Hoo Peh	70,450	" "	
Sgetchuen	166,800	" "	476,707 square miles.
RUSSIA.			
Mongolia	1,500,000	square miles.	
Manchuria	400,000	" "	
Pe Chili	58,949	" "	
Kansuh	86,608	" "	2,045,557 square miles.

This means that the Russian frontier has been extended southward from the Amoor to the Hwai and Yellow Rivers, and for this territory the Siberian Railway must serve as a base of military supplies. A very short line of railroad running from Mukden via Peking (which is now under construction) to the mouth of the Yellow River, aided by the possession of Port Arthur, will make the Gulf of Pechili impregnable and secure the mouth and the valley of the river to its source for Russia so long as it may please that power to hold it. And further: Germany's 65,104 square miles in Shantung will be of little account when once the custom lines of Russia shall have been established, as they assuredly will be, on the banks of the Yellow River. The British "open door" territory will fall into the power of the Russians so soon as an opportunity shall offer and the administration of the northern provinces be firmly established.

Like its Roman prototype, the empire's frontier extensions are cohesive, continuous, continental. It assimilates populations utterly foreign to each other, with ease. In the provinces acquired from the Chinese empire will be found the labor that will till the fields, work the mines, and produce the manufactures of the new Siberia.

It is not generally known that Russia has achieved much progress as a manufacturing nation. In point of fact, she can to-day satisfy all the wants of her own people, both as regards industrial supplies and those derived from agriculture. Her technical development can only be compared to that of the United States. Her cotton industry doubled between 1867 and 1888. Compared with the other great manufacturing countries, Russia's cotton industry ranks third, the United States being second, and Great Britain first. According to the report of the Imperial Department of Com-

* A resume of this article, with a large number of photographic views taken along the route of the railroad, will be found in the current issue of the Scientific American.

merce, the principal productions for 1898 were as follows:

	Number of Factories.	Number of Workingmen.	Total Production, in Rubles.
Textile industries	3,096	419,448	485,000,000
Metallurgic industries	1,373	113,300	112,600,000
Food products	7,809	70,559	235,700,000
Glassware and bricks	2,380	67,346	28,900,000
Animal products	4,625	43,876	79,500,000
Wood industries	1,092	30,703	25,700,000
Chemical products	598	21,134	21,500,000
Sundry industries	419	13,956	31,300,000
Totals	21,243	780,322	1,130,200,000

Estimating the ruble at 77·2 cents, we find that $865,000,000 worth of manufactures were produced in 1898.

The Chinese, as known to the citizens of the United States, are a frugal, intelligent, hardworking race. As irrigators and fruit farmers they are unequaled; as miners, both in placer and fissure mining, wherever they have been permitted to work, they have excelled. For the development of such a country as Southern Siberia they will be found eminently adapted. They are imitative to a degree, docile and obedient, and will make excellent factory hands. We conclude, therefore, that a railroad having farming, mining, and manufacturing prospects like those enumerated above, may be supposed to have reasons for anticipating a successful issue of its financial affairs.

A state railway some 6,000 miles long, however, is necessarily quite an unknown quantity in the business of the world, opening, as it does, a continent. That it will affect the price of staple articles may be set down as a truism. It will, in the end, lower the price of grain, also that of commercial metals, such as copper, silver and steel, by greatly increasing the supply. For the American manufacturers of mining and agricultural machinery, Tientsin, Port Arthur, and Vladivostock will be great markets. Exports of flour and other cereals from Siberia may curtail our shipments to Japan and the Philippines. But the great danger to be apprehended by the United States, Japan and the manufacturing nations of Europe will lie in the probability that the opening up of China, brought about by the building of the Siberian and Chinese railway system, may turn its teeming millions into miners and manufacturers, who will undersell us in our own centers of trade. Our commercial experts are apt to descant upon the probable magnitude of the import trade into China, and to forget that so great a nation, with such enormous resources, may, if stimulated by the same enlightened government that is reaching out for enlarged opportunities of commerce beyond its wide frontiers, become the aggressor in the struggle for the business of the civilized world. By the building of the Trans-Caspian and Siberian Railways, Russia has secured the possibility of securing Chinese events, so far as this may be done by human foresight; the single line now being built from the Ural to the Pacific is but the precursor of other roads to follow wherever they may be needed.

The mere construction of a line of railway extending communication between the ports of the Pacific and those of European Russia would have been comparatively an easy achievement. The builders of the road had immeasurably more than this to accomplish. They had to make a scientific exploration of half a continent, to drain swamps, utilize peat bogs for fuel, lay out irrigation ditches, dig wells, provide for the housing, feeding, and health of incoming settlers and their animals, to erect school houses, bring in agricultural teachers to show the immigrants how to plant, water, and raise crops fitted for soil and climate, make country roads and bridges, arrange rural mail facilities, and a multiplicity of other things about which an American railroad man has not to think. The construction of the railway led to the rectification of navigable streams for the shipment of material, to the sinking of shafts to obtain iron and coal, the laying out of villages for the workmen, the erection of machine shops, plants for the manufacture of cement, and technical schools for railway employes. For purposes of construction it was necessary to examine the mouths of the great rivers flowing into the Arctic Sea, to explore Lake Baikal and place buoys in its channels. The "volunteer fleet" was increased by three great ocean steamers, and railway connection was built to the port of Archangel on the White Sea.

In the Trans-Siberian Railway we have a magnificent exposition of well considered and ordered human endeavor. No one will want to contend that in the accomplishment of so stupendous an enterprise all mistakes have been avoided; but the effort is a noble one, and worthy of the great nation which has undertaken the task.

WOOD SEASONING BY ELECTRICITY.

IN a recent issue of a European trade journal, there is a description of a new process of seasoning wood and timber by electricity, known as the Nodon-Britoneau process. The effect of the electrical treatment seems to be to expel the sap and replace it by insoluble matter which will not putrefy, and to increase the tenacity of the wood and its resistance to vertical compression. This is said to be the first industrial application of the principle of electrical osmose. If the electrodes in an electrolytic solution are separated by a porous partition and a current passes, the volume of the liquid in contact with the positive pole diminishes, while that in contact with the negative increases. The process is about as follows: The positive pole of a dynamo is connected with a lead grating, upon which the wood to be treated is placed. A solution, which is kept at the uniform temperature of 100° F. by means of a steam pipe underneath the grating, is poured into the vat so as to almost cover the log of wood treated. At a public demonstration, the solution used contained 10 per cent. of borax, 5 per cent. of resin, and three-fourths of 1 per cent. of carbonate of soda, the borax being used on account of its antiseptic properties and the carbonate of soda to help dissolve the resin. A porous tray, the bottom of which consists of two sheets of canvas with a sheet of felt between, is placed over the log, and a sheet of lead connected with the negative pole of the dynamo is placed above this. When the current is turned on, the solution is drawn from the bottom and the sap is driven out, and its place taken by the borax and resin; the time required for a 10-inch log is about seven or eight hours, and then the wood is slowly dried, which takes, in the open air, in summer, several weeks or even months. It was stated that a kilowatt hour of electrical energy was required for every 6 cubic feet of timber treated.—Electrical Review.

THE MANAGEMENT OF ELECTRIC VEHICLES.

By GEORGE T. HANCHETT.

RUMOR has it that it is becoming a fad in polite society to be able to manage an electric vehicle. The elite of Newport are said to be taking lessons, and apropos of this search after knowledge, it may be that a short discussion of the matter of managing an electric vehicle with a view to saving the battery and motors, as well as the actual mechanical manipulation of the levers, will be interesting.

The electric vehicle as at present constructed has for its driving mechanism a storage battery, one or more motors and a compound switch or controller. There are usually provided within easy access of the operator a controlling handle, a reversing handle, by which the direction of the vehicle can be reversed, the brake, bell, and switches for turning on the electric light, etc. The battery or source of energy is capable of giving forth a certain quantity of energy, and this quantity in its results varies according to the way in which it is taken out. For instance: If it is called for in large flushes of current the battery will respond, but the total available output of the battery will be less than if the current is taken out in more moderate amounts.

Storage batteries are commonly rated in ampere hours: that is to say, the discharge in amperes that will obtain for an hour represents the ampere hours. The discharge in amperes that will obtain during two hours multiplied by two represents the ampere hour discharge, thus a cell of 100 ampere hours capacity may give 30 amperes for three and one-third hours. If, however, an attempt is made to discharge it at 40 amperes, it is possible that it may succeed in giving this current for only two hours, a total of 80 ampere hours, and with a demand for 50 amperes the total ampere hours would be less, therefore we may lay down as a fundamental rule that to make a long trip with an electric vehicle with a single charge of battery, heavy flushes of current are to be avoided.

A heavy flush of current at the motors may be induced in a number of ways; quick starts, especially on grades, conduce to these excessive charges from the battery; in short, any case where power is suddenly required of the motors. Attempts to start while the wheels are stopped by any obstacle, or bound by the brakes, are similarly detrimental, not only to the charge within the battery at the time, but the actual life of the battery itself, which is none too long at the best.

Another important point in the management of electric vehicles is the starting and stopping. The preliminary acceleration of full speed costs twice as much and often more power as the subsequent energy at the full speed thus once attained. The first application of the energy is to give the vehicle its momentum and to overcome the friction necessary to drive it at a certain speed. As soon as the momentum is obtained, the motor drops to the suitable current that overcomes the friction which obtains. Therefore, if a long trip is to be made, the fewer starts and stops that are incurred the greater the economy of the charge, and the further the vehicle will run on a given charge.

Another point in which the manager of an electric carriage must be careful is the use of the brake. The less the brake is used, the better. It is very enticing to dash up to your destination at high speed and suddenly stop, but it is much more economical to shut off the current a little earlier and coast up to the stopping place. The brakes used consume heat; heat is energy, and the storage battery has to pay for it. Hence use the brake as little as possible.

There is usually provided on the vehicle an instrument known as an ammeter, which measures the ampere discharge at the batteries. By consulting this instrument at any time the manager of the vehicle can tell whether or no he is calling for excessive current, and knowing the capacity of his batteries he will know what current is moderate, what is large and what is excessive.

If long mileage is to be obtained with a single charge it is necessary to run the motors at their most economical speed; that is to say, at their full capacity. The electric motor is very similar to other devices in respect to efficiency. At a light load its efficiency may be as low as 40 per cent.; that is to say, 40 per cent. of the electric energy supplied at the motors appears as useful power at the wheels to drive the vehicle. When the motor is fully loaded, the efficiency may rise to 80 or 85 per cent. and in the larger sizes of motors possibly more. Therefore, it follows that if the capacity of the storage battery is not exceeded, and a long run is desired to be made, the motor must be kept as nearly as possible at its full speed and power. On overloads the efficiency of the motor drops again. It is necessary to depart from the above conditions continually in driving a motor vehicle, but they should be ideals to be aimed at. With poor management a motor vehicle that should make a run of 50 miles may make less than 30.

There is also provided on most motor vehicles an instrument known as a voltmeter. This instrument measures the electrical pressure at which the batteries supply their amperes, and its indications form a very accurate criterion of the condition of the batteries. The batteries should give two volts per cell. Thus, in a battery containing 40 cells the voltage should be 80. On a full new charge the voltage may rise as high as 2·2 volts per cell, thus making the initial starting voltage 88. When the cells are discharged as low as 1·8 volts per cell, they should be considered discharged, for although they are capable of supplying additional power at the reduced voltage the power which must be put back in them to restore them to their original condition is vastly out of proportion to the power that can thus be taken from them.

A battery of cells should never be left in a discharge condition. If this is done, an action which is known as sulphating occurs; that is to say, the acid attacks the plates and forms a corrosive salt, which is detrimental to the cell, and moreover the process is detrimental to the plates. Sulphating can in a measure be removed by giving the cells a heavy overcharge, but the cells should never be allowed to reach such a condition. A sulphated cell is very deceptive with regard to the voltage indications. It is likely to indicate a much higher voltage, at a state of almost complete discharge, than a cell in good order would do.

It is never well to charge the battery inside the vehicle. Means are provided in many vehicles for doing this, but the offensive fumes which are given off in charging are very detrimental to any metal work with which they may come in contact. The cells should be removed when charged. If in handling the cells any of the fluid is spilt from them, especially when they are in a charged condition, it may be replaced with clean water. An attempt to use acid and water may result disastrously. It is far better to have the electrolyte a little too weak than a little too strong.

Storage batteries are in fact the horse of the vehicle, and every effort should be made to learn their frailties and to humor them in precisely the way the horse is humored. Like the horse, if called upon to do an excessive amount of work, they will do it uncomplainingly, but at the expense of their life. In this fact lies great danger in the management of storage batteries. They perform severe tasks without apparent exertion, but presently they will fail to respond altogether, the positive plates being possibly bent or short-circuited and destroyed.

The items of expense in the running of a motor vehicle are: Electricity for charging purposes, maintenance of positive plates of battery, general maintenance of the vehicle, storage and minor charges. The first two of these items are the most severe, and easily amount to 75 per cent. of the total expense. For the rest of the vehicle it may be said that the maintenance compares with the maintenance of an ordinary carriage and harness.

For a two-seated vehicle weighing from 1,000 to 1,500 pounds, capable of maximum speed of 15 miles an hour at a radius operation of 40 miles, the total expense is about $25 per month, the vehicle being in service every day.—The Automobile.

THE DELETERIOUS EFFECTS OF EXPOSURE TO COMPRESSED AIR.

THE human organism is capable of adapting itself to the most varied physical conditions, and it bears changes between extremes with remarkable equanimity, provided the transition be not too sudden. It is quite extraordinary to what extreme degrees both of rarefaction and of condensation of atmosphere men may accommodate themselves. Those made to breathe rarefied air, either at considerable elevations above sea level or in an experimental chamber, exhibit dyspnœa and palpitation of the heart, with acceleration of breathing and of heart-action, lowering of vascular tension, vertigo, nausea, a sense of mental exhilaration, and increase in the number of red blood-corpuscles and the hæmoglobin, all of which appear in intensity and duration in proportion to the rapidity and degree of the change in atmospheric pressure.

Exposure to increased atmospheric pressure, on the other hand, causes primarily acceleration of pulse with heightening of vascular tension, slowing of respiration, discomfort in the ears, and a sense of exhilaration. This condition has been most carefully studied by a number of observers in the workers in caissons sunk for the erection of the foundations for bridges and the like, and a good account of the attendant phenomena, together with a consideration of their mode of production, is given by Oliver in The Lancet for February 11, 1899, page 354. The men are usually exposed to a pressure of two or three times the normal, the transition in each direction being made gradually. The directly resulting symptoms are generally of little consequence, although the operators can safely work only from two to four hours at a time. The most marked disturbances are usually observed on the return to normal air pressure; and they are comparable in a magnified degree to those caused by change from the normal to a rarefied atmosphere.

Oliver reports the case of a man, thirty-five years old, who had been working in a caisson at a depth of seventy-seven feet and under a pressure of from thirty-one to thirty-five pounds to the square inch, and who while returning to his home was suddenly seized with numbness and tingling in the legs, nausea, vomiting, vertigo, and loss of consciousness. After twelve hours consciousness returned, and pain and muscular soreness and stiffness all over the body were complained of. The legs appeared powerless. There was considerable headache, with buzzing in the ears and rather profuse perspiration. On the patient's arising the next morning the nose began to bleed and consciousness was lost again. When consciousness was restored, the arms also were found powerless; agonizing muscular pain was present, together with rigidity; breathing was difficult; there were nausea, throbbing in the head, and oppression of the chest; the patient was cold, collapsed, and perspiring freely; the pupils were normal; the pulse was slow and disturbed. On the following day the muscular rigidity had disappeared, the knee jerks were exaggerated, sensation was unimpaired, and the dyspnœa was less. The urine and the function of the bladder were normal. Vomiting occurred, and somewhat noisy delirium set in. The patient began in a little while to improve, and slowly progressed to recovery.

The symptoms observed in those compelled to work under great atmospheric pressure have been attributed to three factors: carbon-dioxide poisoning, mechanical congestion of the viscera, and increased solution by the blood of the atmospheric gases, with their liberation on returning to normal pressure. It is not impossible that the first and second play some small part at least in the etiology, but the greatest importance is to be attached to the third. The gases absorbed during compression are so quickly set free at ordinary air pressure, but not given off, that they act as emboli in the blood vessels, particularly of the brain and the spinal cord.

The evil effects of exposure to compressed air are

to be prevented by avoiding abrupt changes in air pressure—one minute for every three pounds of pressure being considered not too much. The purity of the atmosphere should be maintained in as high a degree as possible. Only healthy men should be employed, and they should engage in the work for not more than from two to four hours at a time. When symptoms have developed, morphine may be used to relieve pain; heat be applied to the extremities, and stimulants carefully administered, to overcome collapse; strychnine be injected hypodermically when the breathing is impaired; and ergot be given to relieve internal congestion.—Medical Record.

PHAETONS AT THE EXPOSITION OF THE AUTOMOBILE CLUB.—No. I.

THE second exposition of automobiles has just been opened in the Garden of the Tuileries, at Paris. The visitor, upon entering the gate, finds to the right and left two huge canvas tents more than six hundred feet in length and half as wide flanked by two galleries, which also are covered with canvas. It is under these that the exhibits are displayed.

In our examination of the various automobiles here brought together, we shall begin with the phaetons, which are very numerous this year. Of these, we have first the light vehicle manufactured by M. Peugeot upon the same principle and after the same pattern as his large carriages. This phaeton (Fig. 1), which is provided with a motor of three horse power, has three speeds. It possesses a very small radiator. The cooling of the cylinder is effected by water, and the sparking is done by electricity or by a burner, as may be desired. The vehicle is capable of ascending the steepest gradients at a moderate speed and of running on a level at twenty-one miles an hour. It is provided with a seat for two persons. This phaeton is in every respect a most excellent one for making long pleasure excursions or for the use of traveling salesmen.

Proceeding down the aisle we come to the De Dion-Bouton phaeton (Figs. 2 and 7), which is attracting

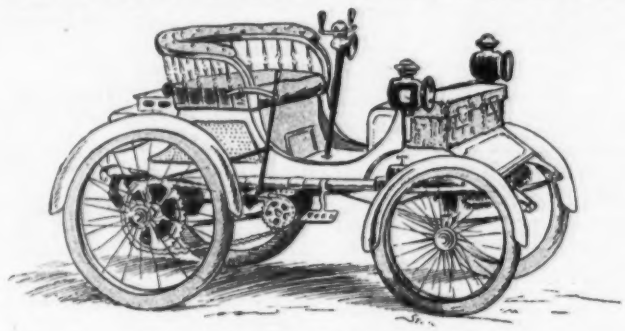


FIG. 1.—THE PEUGEOT PHAETON.

more attention than any other, and which may be regarded as one of the wonders of the exposition. It seats three persons, one in front and two in the rear. It is a very elegant vehicle, in which no part of the apparatus is visible except the steering wheel. It runs in perfect silence, and is driven by a motor of an effective three horse power, which has a single cylinder cooled by water, and a radiator in front. The changes of speed and throwing into and out of gear are effected by simple friction. The starting is done by means of a winch placed at the right-hand side of the vehicle. Finally, under the feet of the driver there are two

FIG. 2.—DE DION-BOUTON PHAETON.

FIG. 3.—DECAUVILLE PHAETON.

pedals, which act upon two very powerful band-brakes. The maximum speed is eighteen miles an hour.

In the Decauville phaeton (Fig. 3), no particular changes have been made since last year. A few slight improvements have been introduced into the details, and that is about all.

The phaeton called the "Phœbus" (Fig. 4) has a seat for two persons, and is provided with a two and one-half horse power Aoter motor. It has two speeds, with progressive change, is steered by means of a hand-wheel, and is started by means of a winch. It is an excellent vehicle for a promenade.

The "Æsculapius" (an odd name for a vehicle) presents a few interesting peculiarities. It is very strongly constructed, upon the principle of large carriages, and is actuated by a simple De Dion motor, upon the back of which is established a circulation of water, supplied by a fifteen-quart reservoir. The water, after passing over the motor, ascends to the reservoir, where, according to the manufacturer, it is sufficiently cooled. The transmission is effected through bevel pinions. There are two speeds—one of seven miles for hills, and one of eighteen for level ground. Another interesting system of cooling is to be seen at the stand of the Société Bourguignonne d'Automobiles. An atomizer with two branches, and actuated by the motor itself, forms, upon the back of the cylinder, a slight deposit of moisture. There is but one defect, and that is that the water is used up quite quickly, and the more so, in that the reservoir contains but a few quarts.

In the space allotted to the Marot-Gardon establishment, we find a phaeton (Fig. 5) of which the three horse power motor of 850 revolutions is cooled by wings. The transmission is effected through bevel pinions and chains combined. There are three speeds (five, eleven and eighteen miles), governed by gear wheels that are always engaged with each other.

The Renault brothers exhibit a new and very handsome phaeton (Fig. 6) which is a miniature of their large two-seat automobile, and which possesses every requisite to make of it a readily managed and very easy riding vehicle. The motor, which is placed in front and entirely concealed, is provided with a Longuemare carbureter, which gives it the advantage of not being able to get out of order on the road under the influence of jarring. The starting is done by means of a winch placed within reach of the driver. Under the feet of

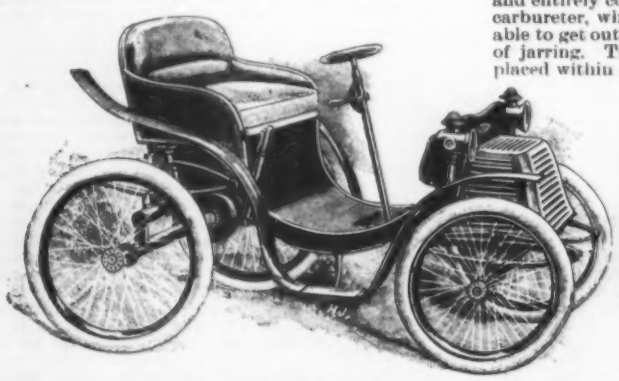


FIG. 4.—THE PHŒBUS.

FIG. 5.—THE MAROT-GARDON PHAETON.

the latter there is a pedal for throwing the motor into and out of gear through the intermedium of a friction cone. For stopping the vehicle, this pedal acts also upon a brake placed under the transmission shaft. A second pedal causes the vehicle to run backward; and a second brake, controlled by hand, acts upon the hubs of the hind wheels. To the left of the driver there is a lever which is capable of assuming three successive positions corresponding to three different speeds. These changes of speed are effected by means of gearings. Motion is communicated directly to the rear axle by means of a 45 degree gear wheel. The three speeds that this phaeton is capable of making are four and three-quarters, nine, and eighteen miles an hour. Let us add that the vehicle occupies no more space than a motocycle.

The principal defect of automobile vehicles is certainly the jarring that is produced in them by the motor while in operation. If we place opposite to each other two horizontal motors, of which the cranks are keyed at 180 degrees, the vibrations will, in such a case, be greatly reduced. This is the arrangement that MM. Turgan and Foy have adopted in their phaetons (Fig. 8). The motor, which is of four and one-half horse power, and consists of two horizontal cylinders cooled by wings, is placed in front. The connecting rods of the two pistons, through the intermedium of two toothed wheels, cause the revolution of a third wheel of double the diameter, upon the axle of which is keyed a flywheel.

Upon the axis of the two first toothed wheels are keyed two pulleys, which, through belts that drive two other pulleys of different diameters, communicate their motion to the rear axle through the intermedium of two trains of gear wheels. Upon combining these two motions it is possible to obtain four different speeds.

The gear wheels are made to engage with each other by means of a lever, and the sliding of the belt over one of the groups of pulleys is effected through another lever. The driver has under his right hand the steering wheel, which is of exceptional simplicity; and, under his feet, two pedals, one of which causes a brake to act upon the axis of the differential gear, while the other causes another brake to act upon the axle of the hind wheels.

MM. Riancey and Gevin have in their vehicle (Fig. 9) solved the problem of the motive and steering fore carriage applied to the phaeton, and have thus constituted what might be called the "automobile horse." The motor, which is of two and one-half horse power, consists of two cylinders cooled by wings, and placed opposite each other in front. The sparking is done by electricity. Upon the steering bar are grouped all the maneuvering apparatus for changing the speed, regulating the motor, etc.

In one of the galleries, that to the right, is exhibited the phaeton of a new manufacturer, M. Querey. This vehicle (Fig. 10) has a seat for two persons, and is provided with a very strong two and three-quarter horse power gasoline motor, cooled by wings and placed in front. It is one of those easy running phaetons that every amateur is now demanding, and the maneuvering of it is simplicity itself. To the right there is a hand-wheel for bringing into gear the wheels that are to give the speed that it is desired to obtain, and a lever designed to tauten the belt, and, consequently, to communicate motion to the hind axle. At the end of a trip this lever acts upon a very powerful brake placed upon the axle of the differential gear. Under the foot of the driver there is a pedal which controls a second brake that acts upon the fellies of the wheels.

Under the driver's hand is the steering bar (for which M. Querey substitutes a hand-wheel or a handle-bar, as may be desired) and the apparatus for maneuvering the motor, etc. This phaeton has the three speeds of four and three-quarters, nine and one-half, and fourteen and one-half miles an hour.

The Levenn phaeton (Fig. 11), which is on exhibition at the Ernst stand, is truly interesting. The two-cylinder motor, in which the cooling is effected by wings and the sparking by electricity, is placed in

front, where it is perfectly concealed although easily accessible. Motion is communicated, through the intermedium of a longitudinal shaft provided with a spring, to a wheel placed near the center of the vehicle. Upon this wheel there acts, through friction, a system of two other and smaller wheels placed at right angles therewith and forming, together, a differential gear. When this system is moved in a parallel manner, the shaft of these two wheels takes on variable speeds that are equal at every instant to the difference of the speeds communicated to each small wheel. A sprocket wheel mounted upon this auxiliary shaft communicates its motion to the rear axle through the intermedium of a chain. It is, therefore, possible to obtain every degree of speed up to eighteen miles an hour. A small hand-wheel placed to the right of the driver serves to effect these variations in speed, while a lever situated to the left permits of obtaining the friction of the two small wheels against the large wheel. A steering bar and a system of powerful brakes allows the driver to run the vehicle with the utmost safety.

For the above particulars and the illustrations we are indebted to Le Monde Illustré and La Nature.

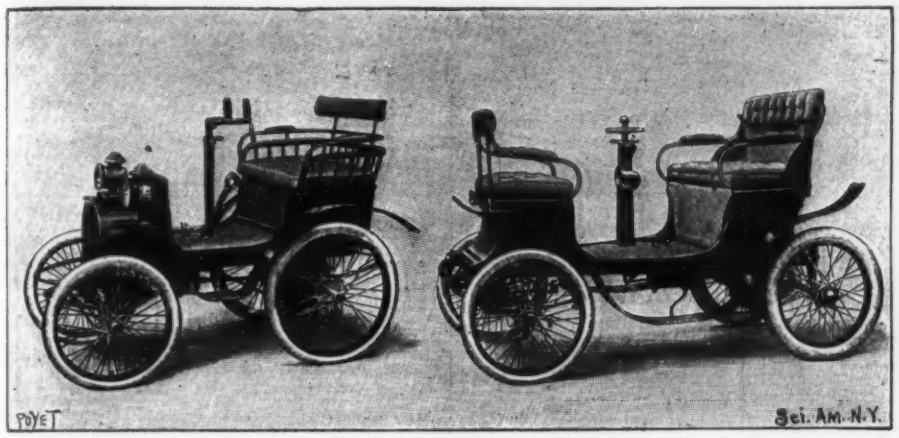


FIG. 7.—THE DE DION PHAETON.

FIG. 6.—THE RENAULT PHAETON.

BICYCLING WITHOUT THE USE OF HANDLE BARS.

IT may be interesting to know that the question of riding a machine without holding the handles has been investigated with the aid of mathematics, and the inquiry has been successful in reaching conclusions of a practical kind. The mathematical part of the investigation we owe to Mr. F. J. W. Whipple, of Trinity College, Cambridge. One of the most interesting points worked out was the condition of stability in a machine ridden without holding the handles. Mr. Whipple finds that there are four "critical velocities" connected by mathematical formulæ for the stability of the motion, which he calls respectively V-1, V-2, V-3, and V-4. For velocities above V-1 (that is, the high velocities) the motion is unstable, but may be rendered stable if the rider turns the front wheel toward the side at which he is at any moment tending to fall, or by his moving his body away from that side. The force he has to employ in the former case is considerable, and, therefore, not to be recommended. In the latter condition the distance he has to move his body is small, and this method of securing stability of motion is thus a practical one. For velocities between V-1 and V-2 (that is, medium velocities) the motion is stable even when the rider does not move his body or make use of his handles, and this is the most favorable velocity for all practical purposes. For lower velocities, less than V-2, the motion, without use of handles, becomes unstable again, but it can be compensated by the rider moving his body a small distance toward the direction to which he is at any moment tending to fall. It will be seen that this is just the opposite to what he has to do to secure stability when the speed is above V-1, that is, high. For very low velocities below V-4 the stability of motion is further decreased, and to preserve his balance the rider has to use his handles as well as to move his body; the balance for such low velocities is not, therefore, automatic, but is a feat of some difficulty, and requiring constant attention.

Coming now into the region of practical cycling, Mr. Whipple finds that for a typical safety machine the following are the values in miles per hour: V-1 = 12·2, V-2 = 10·4, V-3 = 8·5, V-4 = 7·4. The practical conclusion reached is that a velocity of about V-2 is the most important condition in determining ease and stability of riding. A rider moving at the rate of about eleven miles an hour on a typical machine can, therefore, ride without using his handles, and with the maximum of ease and the minimum of conscious effort. What this may mean for the cycling enthusiast it would be difficult to estimate. Spinning along at a speed of V-2 miles per hour along a straight road, he can have free use of both his hands to light his pipe or to do a number of other things. Mathematics have come to his aid and proved that the rider and machine moving at V-2 miles an hour are in a condition of stable equilibrium. He can neglect trifles, such as little pebbles or a small side wind, even when blowing in gusts: for every small displacement thus produced in the moving system is automatically adjusted. True, he may have to touch the handles occasionally to alter his direction; but on the whole, and given a wide path, he can ride on serenely and safely. He need not stoop or lean forward any longer; round shoulders will become a thing of the past. Secure in his speed of eleven miles an hour, he will for the future sit erect as beseems a lord of creation, and from the proud height of his machine feel not only that he can survey the prospect around, but be conscious that rider and machine are at the same time exemplifying the doctrine of stability of motion. It remains only to add that Mr. Whipple's investigations also go to prove that a well inflated tire is further conducive to such stability of riding. Science has thus come to confirm what practice and experience have determined in this as in so many other matters; but it is to be hoped these valuable results may not be taken as a premium on "scorching."—British Medical Journal.

FIG. 8.—THE TURGAN-FOY PHAETON.

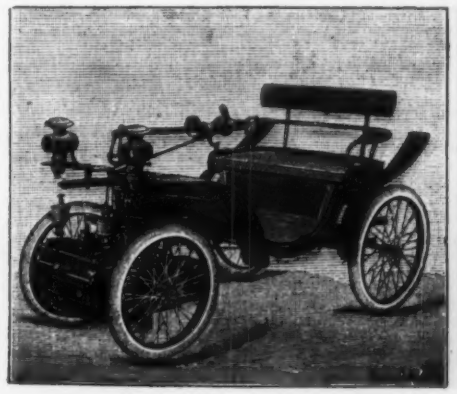


FIG. 9.—THE RIANCEY PHAETON.

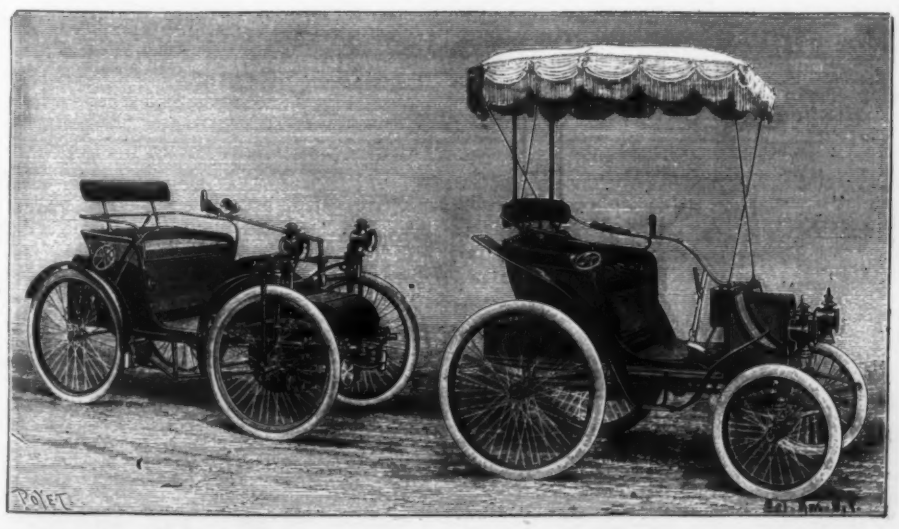


FIG. 10.—THE QUÉREY PHAETON.

FIG. 11.—THE LEVENN PHAETON.

SANITARY WORK IN PORTO RICO.*

By Capt. L. P. DAVISON, Fifth Infantry,

President of Board of Health, San Juan, and Sanitary Inspector, Porto Rico.

I HAVE visited every town of importance in Porto Rico, including the outlying islands, and feel that I can speak with a knowledge of the existing conditions.

The task set before this bureau by General Henry was Augean and much of it has only begun. In this connection the short time we have been at work and the many obstacles to be surmounted should be considered. The unsanitary conditions in and surrounding the city during the last of December were almost indescribable. Most of the 1,500 cesspools had not been cleaned for years. Few of them had any ventilation, and nearly all that pretended to be cemented were leaky; the majority were without cemented bottoms, while many were mere excavations. Cisterns were generally foul and built close to cesspools. Refuse of all kinds was thrown in dark corners of the inner courts or in the streets. Such house sewers as exist were never flushed, and opened into streets and vacant lots. The street sewers were never flushed, and their generally broken condition precluded the proper discharge of their contents.

An attempt was being made to clean two or three of the principal streets when I entered upon my duties. This was done late in the morning, and much of the garbage thus gathered was scattered through other streets and along the road to Santurce, a suburb, where the contractor (?) assorted and disposed of the material. The ordinary dumping ground for such refuse as could not be kept in the houses or dumped into the streets was anywhere out of sight. Perhaps the favorite method was to throw it over a military retaining wall. The conditions in many parts of the city, arising from this practice, were found to be revolting. In the interior of the small houses and the stores no attention was given to cleanliness. Lower floors of more pretentious buildings were occupied by a poverty-stricken and extremely dirty and mixed population, living in absolute violation of all civilized rules. Much of this nastiness was due to lack of water and absence of a proper sewer system. Thanks to the efforts of General Henry, San Juan now has a water system in operation, and the owners should be made to introduce water into their houses. If the inhabitants had studied carefully the question of how to avoid healthful conditions, they could not have done worse. The main trouble was that these people did not realize their filthy condition, and had no sympathy with the efforts of the department commander to put the city in a sanitary state.

The only reasons why this island of San Juan has not become a veritable plague spot are (1) that its surface drainage is exceedingly good and the rainfall heavy during a part of the year, (2) the trade winds sweep over it constantly and in good force, (3) the harbor has a constant flow through it from east to west. Even under these good natural conditions this city has periodically suffered from yellow fever and other low fevers; smallpox has always been more or less prevalent during the winter months and there has been a constant ebb and flow of minor contagious filth diseases.

The first and most important point determined upon was to endeavor to make the sanitary work educative. This has been held steadily in view, and to this end all efforts have been directed. To clean the city was absolutely necessary; to force the citizens to clean up was even of greater importance, but the one grand goal constantly before us was to make these people realize that good sanitation meant (1) the saving of life, (2) an increase in the value of their property, (3) a greater demand for the goods upon their shelves and the produce of their fields, (4) an influx of intelligent capital and work and good wages for the laborer; in other words, that it meant prosperity, and that without good sanitation prosperity could not be permanent.

The city was divided into three districts, and one sub-inspector assigned to each. A thorough house to house inspection was instituted, and a record made of the actual conditions. All public buildings, convents, charitable institutions, etc., were inspected by myself. Military buildings and those pertaining to the insular police were left until such time as a call should be made for such inspection.

The details of how we were hampered in our earlier work by dilatory tactics and open opposition would possibly be interesting, but would simply be restating the history of these people. It is sufficient to say that

* The Independent.

the worst cases have all been attended to and that from eight to ten notices are now issued each day and are being acted on promptly. The people are aiding us now by making reports (in most instances honestly) of conditions that may have been overlooked, but that more frequently have not yet in our opinion been reached.

If a citizen or an inspector reports a house as being in an unsanitary condition, a letter is at once sent to the owner, stating the nuisance, and three days are allowed for its abatement. If the first letter is ignored a second one is sent, notifying the owner that the health bureau will do the work and charge him with the cost, plus 20 per cent. In many cases it has been found that the property holder prefers to have the bureau do the work because of its superior equipment.

In pursuing General Henry's well established plan, Porto Ricans are employed whenever they can be made to do anything like good service. Only five of the thirty employes in this bureau are not natives. These natives require careful handling and constant supervision. They unfortunately have no initiative and little persistency, or what they have of either is of the wrong sort.

Disposition has already been made of thousands of wagon loads of unsanitary deposits. This work demanded early attention. Three general methods presented themselves: (1) Cremation, (2) deep sea dumping from scows and (3) direct sea dumping. Either of the first two methods took more money than was thought to be immediately available and also time. Delay was the principal element to be avoided. A careful investigation of shore line, currents, wave action, etc., was made and a temporary dumping dock was established by slightly improving an unused and worthless piece of fortification from a military point of view. This method has more than fulfilled the highest expectations. Over fifty loads of garbage per day are here thrown directly into the sea and carried out by the current. Garbage cans are being distributed as fast as the people can be made to see their necessity. The disinfectants are being used as occasion demands.

The San Francisco Barracks in this city, completed in 1766, violates in its construction almost every sanitary principle. On this account and also because of its having been the center of contagion in various yellow fever outbreaks its demolition has been strongly recommended. Estimates were requested and submitted as to cost of complete disinfection, and orders were given later to proceed with this work, which has been practically finished. Every square foot of the interior surface of this building has been thoroughly soaked with a strong disinfecting solution. All rotten woodwork was afterward torn out and the ground underneath thoroughly disinfected and cleaned. All loose rubbish was first disinfected and then burned within the inclosure. I shall soon submit to the governor-general a report as to repairs to and the precautions that should be taken with this building.

On March 3 the first case of smallpox showed itself in this city. Before this time various preventive methods, such as quarantine against the interior towns, inspection on the roads, ferries, etc., were discussed, but, barring vaccination, which was proceeding under the capable medical officer of the department, it was decided to keep simply a close watch on those parts of the city where smallpox was most likely to develop, and if it should appear, to treat it rigorously. Pursuant to these plans, a detached bastion was selected as a location for an isolation hospital. Every suspicious case was immediately removed to quartermaster's tents in the vicinity, and as soon as the disease indicated unquestionably that it was smallpox, the patient was taken into the regular hospital. The houses from which patients came were immediately and thoroughly disinfected, and all the occupants were vaccinated. Sixty cases, the majority of them chicken-pox, have been reported, originating in twelve sections of the city, and had it not been for the introduction of water and the general vaccination, together with the work of my bureau, credit for all of which belongs to General Henry, it is generally admitted that San Juan and other towns on the island would have been scourged with the disease. The type has been uniformly mild, and no deaths have yet been reported. Cases of chicken-pox, varioloid, and smallpox were all isolated. From the class of people attacked it is believed that cleanliness of person, proper living, and morals are at least equal to vaccination as a preventive of smallpox. A million vaccine points are in the course of preparation at the government vaccine farm at Coamo Springs, under the immediate direction of Major Azel Ames, and officers of the medical staff of the department are busily engaged in applying the virus to the people of the island.

I believe that another year of careful watching, strict and impartial treatment and thorough vaccination should bring this disease within the bounds of civilization. The most modern precautions are taken before the patient is discharged, and the Women's Aid Society has furnished the clothing for the women and children. This society, originated by Mrs. Henry and composed of the leading American and Porto Rican women of San Juan, is doing a vast amount of good. I hope the full extent of their worthy efforts will be realized, and that they may receive not only the credit they deserve, but such outside assistance as will assure a continuance of their work among the poor of this city.

Consumption claims the highest percentage of mortality on the island, and the most modern ideas are being used to prevent its spread. There are now fourteen lepers in a temporary hospital near San Juan. They are well guarded, furnished with rations and are being attended to by the health officer of the city and by a man and his wife. Other cases of leprosy, when reported, are taken care of as soon as possible. Absolute isolation is being insisted upon, and steps looking toward permanent colonization of these unfortunate sufferers are being taken. This is in accordance with the latest scientific methods. These cases are generally discovered in remote localities and among the poorest class of natives.

Public opinion has already been greatly modified and we hope somewhat educated in the matter of treatment of contagious diseases, and a continuation of these methods should make this island as free from these diseases as any equivalent area on the face of the globe. Quarantine regulations are being strictly and impartially administered and order is being rapidly brought out of chaos and favoritism.

The death rate out of a population of 32,000 for the quarter ending March 31 was 33 per 1,000, and shows a marked decrease since our work began. Former data under Spanish rule have been found too unreliable even for quotation.

A start has been made in the direction of decent interment of the dead by locating the military cemetery well outside the city. The next step, that of closing the old intramural, overcrowded and noisome cemetery, should be soon taken. The land is now available, satisfactory arrangements for transportation can be made, and Archbishop Chapelle, as the representative of the Catholic church, has given his promise of hearty co-operation.

The question of cleaning out several blocks of houses whose location, construction and inhabitants almost defy sanitation, is receiving due attention under orders from the department commander. A full report will be rendered to the governor-general as soon as the circumstances warrant. The questions of property ownership are very much involved, and require a painstaking research and careful investigation. There is room for only about 12,000 of the 16,000 inhabitants now in the city proper. San Juan is now so overcrowded as to entail the usual evils of overcrowding in the tropics. These people are able to pay from four to six pesos ($2.40 to $3.60) a month, and at present find miserable shelter in basements and unsanitary courts. This makes it impossible to improve their moral and social conditions, and their continued presence is a menace to the public health and prevents the proper renovation of these quarters.

Gen. Henry has consented to grant permits to build suitable sanitary tenements on the public land at the eastern end of the island of San Juan, and invitations for bids have been made.

Under present conditions, however, private capital, I am sorry to say, seems shy of this investment. It is proposed to construct tenement houses, each section of which would accommodate an average family, say three adults and four children. Corner apartments would be advantageously arranged and rented as shops, groceries, etc., of which these people apparently require many. Two rows of such tenements, back to back, would form a block. City water is convenient, the ground lends itself to good sewerage. There is ample space for all buildings, streets, parks, etc., and the location is altogether desirable.

I hope it will not be considered out of place if the inception, intelligent furtherance and unswerving support of this work by every available means in his power is attributed to Maj.-Gen. Guy V. Henry, the governor-general. Without his firm convictions and broad grasp of the conditions, little or nothing could have been accomplished. I am also indebted to the Marine Hospital Surgeon, A. H. Glennan, whose experience especially fits him for his present condition. Together we have labored earnestly to overcome the inertia and the sometimes poorly disguised hostility of the people and their representatives, but improvement is now quite noticeable in this matter. The two native doctors and the two councilmen on the San Juan Board of Health are capable men, interested in and working hard for the public good.

The running expenses of my bureau for the quarter ending March 31 were less than $2,900. It is estimated that these expenses for the quarter ending June 30 will not exceed $5,500.

I hope that in the budget of the next fiscal year this and other cities on the island will provide moneys for sanitary work, although the ignorance and shortsightedness of the parties most interested should not, I believe, lead the United States to retard the work by a too close hold on the purse strings. Good sanitation is the visible sign of civilization, and it is only a question of time when it must come. Are the American people willing to take the responsibility for the deaths, suffering and misery if this reform is delayed even one year?

CLIMATE OF THE HAWAIIAN ISLANDS.*

By Albert B. Lyon, M.D., Honolulu, Hawaiian Islands.

Perpetual June! There is no other month in the Hawaiian calendar. We have the names, it is true, January, February, and through the list, but the skies of January, the showers of February, the roses of March are June skies, June showers, June roses. It would be wearisome to go further with the enumeration. Why should it not be so? Lying in mid-Pacific, just within the limits of the torrid zone, in the belt of the northeast trades, how could the climate be other than equable and mild? Such expressions are vague and relative. Let me present a little of the detail of fact.

It is seldom that the thermometer in Honolulu registers a minimum temperature as low as 55° Fahrenheit. One who is not an early riser might truthfully say that in a five years' residence in that city he had seen the mercury only once as low as 60°. The days in the year having a mean temperature of less than 70°, or an average for the twenty-four hours as low as 67°, you could count on the fingers of one hand. About as rare, on the other hand, is a morning temperature above 76°, or a midday maximum in the shade as high as 87°. Of course in sheltered spots exposed to the direct glare of the sun in the summer months, the temperature may rise to 90°. Only once in eight years of daily meteorological observations have I seen the thermometer really as high as 90° in the shade. In my study, with windows (screened with wire gauze) nearly always open to admit the breeze, the extreme range of the thermometer during three years of continuous observation was from 65° to 83°. About three days in the year the average temperature was as high as 80°, not once 81°; this in spite of the fact that the room, not a large one, was lighted during the evening by a Rochester lamp. About four days in each year the average temperature was below 70°, only once as low as 68°. Even more rarely was the temperature at 9 P. M. below 70°. Between the middle of April and the middle of November, 1893, the daily average was only twice below 75° and only twice below 79°. Is it strange that few houses in Honolulu indulge in the luxury of a fireplace?

Equable? Yes, you say, but rather warm. So it is, in Honolulu, and for that matter at any point near sea level. But whatever may be said of the possible debilitating effect on some constitutions of our perpetual summer, there is little in it to complain of on the score of comfort. The temperature rises by imperceptible gradations from February until September. Some days in May and June, before the trade wind settles to its summer pace, suggest the idea that the sun is coming uncomfortably close, but before many hours the breeze freshens and you conclude that nature was merely inviting you to the luxury of a swim in the half tepid water of the Pacific at Waikiki.

Warm days are common. They are the rule in September, but there is seldom a suggestion of sultriness in the air. If there is "muggy" weather at all, it is in the cooler part of the year. In summer the dew point is at least ten degrees lower than the air temperature in the daytime. A sultry night is unheard of. The air always cools sensibly before nightfall, the night temperature being ten degrees lower than that of the daytime. If there is little wind, the difference in temperature is correspondingly greater, the minimum being then occasionally as much as twenty degrees below the maximum.

One is surprised to find how little of fierceness there is in the rays of the nearly vertical sun. In the Eastern States one often dreads to step out of the door in summer at midday. In Honolulu you can run out on an errand bareheaded in the sun without thought of discomfort. Such a thing as sunstroke is unheard of. In truth, the direct rays of the sun have far less power than where the upper atmosphere is less charged with moisture. A thermometer placed in the full sunshine will register only 105° to 115°, possibly 120°; a California sun, I am sure, could do more than that.

What I have said of temperature applies to Honolulu; and the Hawaiian Islands are large enough and high enough to furnish choice of climate. Even at the sea level there are important differences, depending upon rainfall and wind. You may choose your residence at an elevation that will reduce by five or even ten degrees the temperature the year through. Some of the coffee lands on Hawaii lie 1,000 to 2,500 feet above sea level, and you may reckon a lowering of the mean temperature of about three degrees for one thousand feet. The difference will be less in the daytime, but greater at night.

The first question a prospective immigrant will ask is, Can I work in such a climate? I believe that it is safe to answer in the affirmative, whatever be the character of the work. The danger is that if you come from a country where climate forbids work of a certain kind for days and weeks together, you will over-exert yourself, from the instinct to make the most of the present exceptionally favorable opportunity. When you have lived here for ten years, you may fall into the opposite error of putting off until to-morrow work that can be done as well one day as another.

Any one who has kept a weather record has learned that the thermometer alone does not indicate temperature as our sensations interpret it. Comfort depends quite as much on the degree of humidity as on the temperature of the air. It may be stated in a broad way that we are not likely to suffer discomfort from excessive dryness of the air. It is an air saturated with moisture which interferes with nature's provisions for maintaining in the body a constant temperature. In parts of California temperatures of 115° F. and upward in the shade are far less distressing than the excessive heat that the Englishman complains of with the temperature no higher than 80°. In California the air is very dry, while in England it is likely to be nearly saturated with moisture.

The climate of the Hawaiian Islands anywhere near sea level, even in localities where the rainfall is excessive, is dry rather than humid. It is rarely that the air contains less than one-half the moisture it is capable of holding in invisible form. A relative humidity exceeding 90 per cent. is equally rare, and is experienced only during rain storms. One can tell what is the relative humidity very nearly by observing the altitude of the clouds as they hang over the mountain. It is seldom that there is anything approaching a fog at sea level. The clouds will occasionally descend so as to cover the top of Diamond Head, which is about 760 feet high, and very rarely may rest in the crater of Punchbowl, which is barely 500 feet high.

More commonly, even in southerly rain storms, they maintain an altitude of 1,000 feet at least. The trade-wind clouds rarely descend below the 2,000 feet limit. This simply means that, at the respective elevations mentioned, the air is saturated with moisture. It follows that one who desires it may find as humid a climate as he may choose. The resident of Honolulu, without going to an inconvenient distance from business, may suit himself with a climate graduated to a nicety in this respect, his home, if he pleases, at the base of parched and arid Diamond Head, or amid the luxuriant verdure of upper Nuuanu Valley, the forest-covered slopes on either hand much of the time lost above the clouds.

Of course, in the one locality he will have his skies for the greater part of the year only flecked with passing clouds; in the other the blue sky will be seen half the days in the year only fitfully in glimpses. Honolulu itself certainly has its share of sunshine. For about two years I kept a photographic record of the amount of sunshine. Very rarely would the record show absence of clouds all day. Only twice, if I remember rightly, was there no record at all, although there were a number of cloudy days with less than an hour of partial sunshine. The record for the year shows an average of 55½ per cent., the lowest average being that of February—38 per cent.; the highest that of September—68 per cent.

The statistics of relative humidity show an average for the year 1894 of 64·4 per cent. at midday and 78·9 per cent. at night. The figures for February were midday, 72 per cent.; night, 83 per cent.; for August, midday, 58 per cent.; night, 76 per cent.

Wet and Dry Seasons.—In the Hawaiian Islands there are only two seasons, distinguished by the presence or absence of the trade wind. While the trade wind blows, and that is at least eight months generally in the year, the mountain summits are constantly

* Read before the Detroit Academy of Medicine.—From The Physician and Surgeon.

wrapped in clouds, from which drop frequent showers. For points under this cloud canopy this is the rainy season, the actual rainfall depending upon the local conditions affecting condensation. In the case of a high and bulky mountain like Haleakala, the precipitation is wholly on the windward side, the clouds being dissipated before they can reach the sheltered side, where rain with a trade wind blowing would be simply a miracle. If the mountains are only three or four thousand feet high, as on Oahu, the clouds form as the air is lifted over their summits and pour down rain chiefly on their leeward slopes. From the cloud mantle which envelops day after day the mountain top, the stronger gusts of wind tear away tattered fragments which are borne to leeward, trailing after them fringes of rain and mist. This is the explanation of those showers which take the malihina (vernacular for tenderfoot) so by surprise, the azure of the sky in the south and west quite untroubled—the unclouded sun shining on unconcerned, not forgetting, however, to paint in the background of mist, sometimes apparently on what seems clear blue sky, gorgeous fragments of rainbow. The Hawaiian names this ua kamaaina, rain that is native to the land, in contradistinction to the storms that come from without. In Honolulu through the summer months these trade wind showers, coming at all hours of the day, generally as a mere sprinkle of rain, but more numerous and much more heavily freighted in the night, serve to mitigate the tendency to drought, and are sufficient often to keep the grass green on the hills. We expect in Honolulu one to two inches of rain a month from these showers, but we are sometimes disappointed. The farther manka (inland) you live, the more generous will be the tribute of the clouds. At Waikiki, three miles to leeward, the monthly average will be less than half an inch; at Punaleon, close to the mountains, it is about two inches; two miles up Nuuanu Valley it is nearly twice as much, and two miles farther, close to the summit of Konahuanni, you expect six or eight inches, and, since this is the source of an important part of our water supply, we in Honolulu find no fault if it is ten or twelve.

On Hawaii, with the giant mountain Mannakia for a condenser, the sugar and coffee lands draw on this supply for an average of ten or fifteen inches in a month, and sometimes are favored with fifty inches or more. One station has a record for April, 1895, of two and a half inches a day for nineteen consecutive days, and a total for the month of over fifty-four inches.

It is customary to speak of the trade wind season as the dry season. From what I have just said it is evident that this is true only for leeward stations. In Honolulu, for example, the earth generally becomes parched in the summer months in spite of the frequent sprinkling it receives from trade wind showers. When the trade wind is interrupted, the atmosphere over the ocean becomes charged with vapor to a greater degree than is possible during the prevalence of a northerly wind. The weather may, nevertheless, be fine for weeks together, but the conditions are favorable for the development of cyclonic storms, and it is from these that the parched lowlands get their only really efficient watering. These storms develop slowly. The sky becomes overcast. It may be a day or two before the clouds begin to discharge their burden, but when they make up their mind to it, there is no limit to their generosity. Sometimes the storm is accompanied by thunder and lightning, more often not. The lightning plays from cloud to cloud, seldom striking the earth. The thunder reverberates grandly, but even the most nervous are little alarmed by it.

Once only in a residence of fifteen years in Honolulu have I known lightning to strike the earth. Then the storm was one that would have done credit to Illinois. The storm may be accompanied by strong wind. More often the wind dies out entirely when the rain begins, and then you wonder where such an amount of water could have been stored. An inch or two is a common rainfall in one of these storms, but three to five inches, within twenty-four hours, is not unusual, and we may be embarrassed with a gift of eight or ten where one or two would have been very welcome. Storms like these, in the nature of things, cannot last indefinitely. Commonly, twenty-four to thirty-six hours is the limit of their duration; within three days at most the clouds discharge their burden, and then succeeds a fortnight of sunshine.

These storms may have nothing directly to do with the moon, but they are apt to recur month after month at about the same date, or the interval may be one or two weeks.

A few figures will bring out more clearly the contrast of seasons in respect of rainfall in places quite close together. Last year, there were in Honolulu 150 days of rain record, with a total rainfall of 37·61 inches. At Waikiki, three miles to leeward of the Honolulu station, there were only 65 days of rain record, rainfall 21·83 inches. At Luakaha, four miles inland, with 148 days of rain record, the rainfall was 89·75 inches. Now, if we omit from the record the ten days of the principal storm rains, we shall have remaining for Honolulu 22·55 inches; for Waikiki, 7·29 inches; for Luakaha, 68·29 inches, representing mostly rain accompanying trade winds (ua kamaaina).

During the same period Olowalu, under shelter of the west main mountain, recorded 10·70 inches of rain, there being but seventeen days of rain record; Olaa, with Mannakia as a condenser, had rain on 255 days out of the 366, reporting altogether 176 inches, and this was by no means a record-breaking year. During the four months, April, May, June and July, Olowalu had no rain at all, while at Olaa there were more than 72 inches, and only nine days without a rain record (only four more with less than 0·10 inch).

Once more: On opposite sides of the same island, in April, 1895, Olowalu reported 0·16 inch of rain, while Hana claimed 23·54 inches, with a memorandum that, of this, 21·13 inches fell on a single day, and 14·30 of it in four consecutive hours!

Evidently, as regards humidity of climate, the Hawaiian Islands offer a wide range of choice.

One word only on the important subject of our winds. During the winter months, we take what comes in that line; about half the time it is a light southerly breeze, against which the people of Honolulu have an inveterate prejudice. The discomfort it brings to sensitive subjects is probably due more to the moderated humidity of the air than to any malarial influence. At any rate there is a sense of strangeness as long as the wind is wanting in our environment. During the spring months, before the trade wind is fully established, we expect more or less blustering weather, keeping up the traditions of March wind. In April or May, however, the wind settles down to a steady pace, a good stiff breeze, which sometimes stirs up more dust than is agreeable, but which insures for city dwellers a salubrious air. Its velocity is commonly from ten to twenty miles an hour. In some exposed localities it blows thus with so little interruption that trees, sugar cane, the grass itself, all lean strongly to leeward. Under shelter of the higher mountains there are regions where only accidental breezes blow. On the west coast of Hawaii land and sea breezes are almost as much a matter of course as the rising and setting of the sun.

When vitality is low and the system needs repose rather than stimulation, a climate subject to no extremes, inviting one continually into the open air, bright but not excessively hot, breezy yet reposeful, is worth crossing an ocean to find. Not a few have experienced its health-restoring powers. When the increased demand shall warrant the establishing of sanitariums not alone in Honolulu, but in the more bracing atmosphere of the mountains of Mani and Hawaii, we may expect to be called on to extend hospitality yearly to hundreds of health seekers, each one of whom will send others on the same errand.

AN ANGLO-SAXON "STORY OF THE HEAVENS."

By E. WALTER MAUNDER, F.R.A.S.

I CHANCED on one occasion to be present at a debate in a literary society on the subject of "Education." The gentleman who opened the debate spent most of his time in expatiating at great length, and with many repetitions, on the profound ignorance of our forefathers. We were reminded that up to comparatively recent times even the nobility could neither read nor write, and that education scarcely had an existence in this country until the institution of school boards rather late in the Victorian era. I was the only person who ventured in any way to call in question this somber picture of the past, and my statements on the other side were received with marked incredulity.

This little experience has suggested to me that perhaps it might not be unwelcome to some readers of Knowledge to have some short account of a little popular manual in astronomy—popular in a two-fold sense, as being written for "the unlearned," and as enjoying a wide circulation—which was current in this country very nearly a thousand years ago. I take astronomy as an example, partly because it is the oldest of the physical sciences, and because a widespread attention to it is clear evidence of a state of education fairly advanced in several directions as well as of an attachment to knowledge for its own sake.

The little manual in question appears to have been written during the reign of Ethelred the "Unready" (i. e., the uncounseled or ill-advised), a time of violence and disturbance, which can have been by no means favorable for a general cultivation of science. The book is an abstract in the vernacular of a Latin treatise by the Venerable Bede, "De Natura Rerum." The author of the abstract is not known, but it has been ascribed with some probability to Ælfric, the "grammarian," and translator of a large portion of the Old Testament Scriptures, and, indeed, its style is not unlike in its clearness and simplicity the "Homilies" for which he is famous.

As was necessarily the case in a book intended for wide circulation before the invention of printing, the treatment is exceedingly concise, and the whole book does not exceed in amount five pages of Knowledge. In this short space we have the creation of the world treated of, the nature and typical significance of the sun, moon, and stars, of the first day of the world and of the vernal equinox, of night and its divisions, of the year and the zodiac, of the relations of the sun and moon, and of their movements, of the time of the equinoxes and the solstices, of leap year, of meteors and comets, of wind, rain, hail, snow, and thunder.

The book bears the name, when complete, of "De Compoto," but occasionally it is found without its first chapter. The second chapter is entitled "De primo Die Sæculi."

The first point which would, I think, strike most modern readers is the clearness with which the writer has grasped the fact of the rotundity of the earth. It is clear to him that the earth stands in empty space, having the heavens as far below it as they are high above it. This he teaches again and again, sometimes directly, sometimes incidentally.

> "Seo heofon belyeth on hyre bosme ealne middan-eard, and heo æfre tyrnth on butan us, swiftre thonne ænig mylnn-hweol, eall swa deop under thyssre eor'dan swa heo is bufan."

"The heaven envelops in its bosom all the middle-world, and it always turneth about us, swifter than any millwheel, all as deep under this earth as it is above." Similarly, he describes how our "earthly night soothly comes through the earth's shadow, when the sun goeth in the evening under this earth, then is the earth's broadness betwixt us and the sun, so that we have nothing of her lighting till she is at the other side uprisen." "Assuredly it is a wonderful thing that this worldly night is nothing but the earth's shadow betwixt the sun and mankind." Again, "the earth stands in the very middle through God's might, so fastened that it never moves higher or lower than the Almighty Shaper, who holds all things without effort, has established it."

He gives a proof of the form of the earth incidentally by remarking, "truly the day of equinox is one for all the world, and equally long, and all other days in the twelve-month have different lengths. In some lands they are longer, in some shorter, through the earth's shadowing and the sun's going about. The earth stands in the likeness of a pine nut, and the sun glides about it by God's setting, and on the end where she shines it is day through her lighting, and the end that she leaves is overcast with darkness till she is thither returned again. Now, it is the earth's roundness and the sun's going about that prevents the day from being in each land equally long."

I think we may pause here to note how greatly in advance our author was of those who in recent times have been bitten by the stupid "flat-earth" opinion. He clearly had a sufficient grasp of spherical geometry to see that the variation in the length of the longest day in different latitudes was explicable only on the theory of the rotundity of the earth.

It may be pointed out, on the other hand, that he places the earth in the center of the solar system, and makes the sun and the stars revolve round it. This and another error to which we shall allude presently are the only two of any consequence in the entire manual, which on the whole is written in a strictly scientific spirit, that is to say, it is based upon actual observation and on strict and careful reasoning therefrom. Nor is his following of the Ptolemaic theory a departure from this. For it is clear that he had no sufficient means of disproving it, and it amply sufficed to explain such observations as he could make.

The geographical information which had reached him varies in accuracy. He correctly speaks of India as lying partly within the tropics. "In the land of India turn their shadows in summer southward and in winter northward." But he is mistaken when he places Alexandria actually on the Tropic of Cancer. "In Alexandria goeth the sun right up on the summer solstice at midday, and there is no shadow on any side." But a line or two further he states quite correctly, "In the land that is called Alexandria the longest day has fourteen hours," which is exactly correct. For Italy he gives the longest day fifteen hours—correct for Campania; and for England seventeen, which is its duration in Northumbria, the land of Bede, the author of the work he is popularizing.

He is quite clear as to the division of the earth into the five zones; although of course no report had reached him of any hardy voyager who had penetrated south of the equator. "Then there are," he writes, "on two sides of the torrid zone, two parts that are well meted, neither too hot nor too cold. In the northern part dwell all mankind." Nor does he seem to have known of any exploration within the Arctic circle, for his description of "Thile" is that it is an island where there is no night for six days at the summer solstice, as the sun then sets and immediately rises again.

As this little manual was clearly intended not for the learned—that is to say not for the monks and clergy—but simply for the common people who could speak and read no language but their own, and to whom Latin, then the universal language of the cultured, was a sealed book, its author has thought it well to add a little caution here and there where he thought there was a danger of his descriptions being misunderstood. He therefore supplements his description of the long summer days of Thile by the emphatic caution that "there is always in a day and night four-and-twenty hours," neither more nor less.

His description of the stars, though very brief, might, we have much reason to fear, put to shame the ignorance of many thousands of dwellers in English towns and cities of to-day. He describes clearly how certain constellations, as, for example, the Great Bear, never set in England, while other constellations round the South Pole never rise here, and we, consequently, know nothing of them. He points out, too, that there is not only a North Pole star, round which the whole heavens appear to revolve but which itself moves not, but there is also a southern one, "for on these two stars the firmament turns as a wheel turns on the axle." Other stars, again, both rise and set, going from east to west, and are visible at different times in the year. Thus, the Pleiades "through all the summer go at night time under this earth and in the day above; in the winter time they are up at night and down by day."

With regard to meteors, our writer cautions his readers that they must not suppose that they are real stars falling from their places. "Truly there are yet as many stars in heaven as there were at the first when God shaped them." He then mentions the seven planets "which are not fast in the firmament, but have their own going severally," but he considers this too deep a matter to enlarge upon for "unlearned men." Of comets he simply says that they appear suddenly and unaccountably, "and have long rays like a sunbeam. As oft as they appear they betoken something new toward the people that they overshine." This seems the only indication in the little treatise of any leaning toward astrology. Indeed, the writer says expressly that the Christian man who takes to divination by the moon has forfeited his faith.

He equally repudiates a delusion which is very widely current even at the present time, namely that the position of the moon's horns when crescent betokens the kind of weather that is to come. "If the sun lights him from above then will he stoop, if she light him right through then he will be equally horned." (The sun, of course, in Anglo-Saxon is always feminine, the moon masculine.) "Now argue some men who do not know this reason that the moon turns him as the weather shall be in that month; but never from his nature will weather or unweather turn him." On the other hand, he fully believes that "trees hewn down at the full moon are both harder against wormeating and longer lasting than those hewn at the new moon."

Similarly he evidently regards eclipses, whether of the sun or moon, as perfectly regular instances in the order of the universe and not in the least as portents to alarm men. He carefully explains the causes of both kinds of eclipse, and mentions that the moon's orbit does not coincide with the ecliptic, but that he goes both to the north of it and to the south, and that it is when he is new and when his track coincides with that of the sun that he is able to eclipse her. Then comes the remark so common in all the ancient notices of eclipses, "and the stars appear as at night." It should be remembered that total eclipses of the sun were by no means so unknown in England in the Saxon period as they have been for the last seven hundred and fifty years. There were no fewer than five which had occurred in the four hundred years preceding the publication of this little manual. One, indeed, had taken place during the lifetime of our author, but seems to have been total only for Cornwall, which was not then part of England. It is very curious that in all these ancient records, while we find absolutely no notice of that which strikes our attention so forcibly in eclipses nowadays, namely, the shining out of the corona, we are told of the appearing of stars, a phenomenon which by no means forces itself on the at-

tention, unless perchance, as in the eclipse of last year, Venus or Jupiter happen to be near the sun. Can it be that the corona was less conspicuous then?

There are several other points of interest in our treatise. For instance, his explanation of leap year is a model of brevity and clearness, and he is careful to explain that it has nothing whatsoever to do with Joshua's miracle. He fixes the day of the vernal equinox as St. Benedict's Day, March 21, and not Lady Day as some considered it to be. One little bit of traditional superstition shows itself, when he says that "the equinoctial day was the fourth day from the shaping of this world. On the fourth day from the shaping of this world, the Almighty Shaper made the sun and set her in early morning in the mid east, where is told the equinoctial circle. The same day He set the moon full in the evening in the east, together with shining stars in the course of the harvest equinox." Of course he overlooked the fact that if the sun was suddenly called into existence at any moment of time, it would be rising in the east only to places on one particular meridian. But the oversight was a very venial one in the Saxon, who wrote at a time when the known inhabited world was not only confined in latitude to the north temperate zone, but also in longitude to no more than six hours at the very outside. Then, again, though they might have reasoned it out that local time must differ from meridian to meridian, yet they had absolutely no means of determining it. Nor have we any reason to exalt ourselves against our forefathers when we see in our own day—a day of chronometers and watches, of standard and railway time, and of telegraphs—that precisely the same superstition, with the solitary substitution of the autumnal equinox for the vernal, has attained an immense circulation in the writings of sundry quack soi-disant chronologists.

We cannot give equal space to the other points that are still worthy remark. Ælfric—if Ælfric it was—explains exceedingly clearly the cause of the moon's phases, and points out that no matter how little or how much of her surface is illuminated, she always in truth remains a perfect orb. Here, however, analogy leads him into a serious mistake. For recognizing that the moon and planets shine by reflected sunlight, he generalizes hastily that the stars owe their light to the same cause.

This mistake is partly the reason why he attains to what, under all the circumstances, we must consider a very advanced view of the size and distance of the sun. Seeing that the stars shine at night, and believing that they receive their light from the sun, he is compelled to think that "her light ascends by the side of the earth, and lights up the stars above us." He infers, therefore, that "the sun is exceeding great; all as broad she is as all the whole compass of the earth, but she seems to us very narrow because she is very far from our sight." "Also the stars that seem little to us are very broad, for they might not send any light to earth from the high heaven if they were so small as they seem to our eyes." Then he argues that the moon must also be very great, inasmuch as in a total eclipse he hides the sun. It is, however, far less distant from us than the sun, for "soothly the moon's year has seven and twenty days and eight hours. In that time he under-runs all the twelve signs that the sun goes under in twelve months. The sun's running is very wide because she is very high up; the moon's running is very narrow, for of all the planets he runs the nethermost and to the earth the nearest." The brevity of his treatise does not allow him much indulgence in analogy or illustration, but on this one occasion, to make his point quite clear, he continues, "now that thou mightest understand, that a lesser going around hath the man who goes about one house than he who goes round all the burgh, so also the moon hath his running quicker run out on the lesser circuit than the sun hath on the greater." May we not see in this little analogy the germ of that wealth of illustration, metaphor and anecdote with which the Lowndean professor makes the science of astronomy so vivid and delightful to his audiences to-day?—Knowledge.

TRANSPORTING POWER OF THE WIND.

THERE are few people, aside from geologists, who realize the transporting power of the wind in the geological sense. This ability of the wind to shape the topography of the earth's surface is known as Æolian erosion. In many places it has manifested itself by piling up mountains of sand in great dunes, and in other places the drifting sand has scoured the rocks into fantastic shapes and polished their exposed surfaces like an artificial sand blast. At the mouth of the San Gorgonio canyon, on the line of the Southern Pacific Railway, in Riverside county, Cal., not far from Whitewater station, the rocks on the west side of the road are carved in deep ruts and polished by the sand and gravel driven before fierce blasts of wind, which rush down through the narrow pass between the San Bernardino and San Jacinto mountains onto the Colorado desert, to fill the space made by the rapidly rising air which ascends from that heated land. Near Palm station, where the wind loses much of its force, the sand is piled up in great dunes, some of which rise 200 or 300 feet above the desert plane. Still farther down toward Pilot Knob, near the Mexican boundary, the winds which rush across the Salton basin have piled up miles of sand dunes. These are ever shifting, always changing. On almost any clear day scores of whirling columns of sand, mounting often over 1,000 feet into the air and visible for miles, may be seen over the vast expanse of this desert. These instances are only mentioned as characteristic of many other places on the Colorado and Mojave deserts of California, and in hot, dry, sandy countries everywhere. Along the sea coasts and lake shores, where not rocky, sand dunes are of very common occurrence. A large portion of the city of San Francisco, Cal., is built on sand dunes, formed by the drifting of sand from the shores of the Pacific, driven by a prevailing southwesterly wind. In places these piles are 100 feet or more in thickness. In some places growing forests have been enveloped by drifting sand, and in after years the sand blown away again exposes the dead forest.—Mining and Scientific Press.

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TABLE OF CONTENTS.

PAGE

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II. ASTRONOMY.—An Anglo-Saxon "Story of the Heavens."—By E. WALTER MAUNDER..... 19769

III. AUTOMOBILES.—Phaetons at the Exhibition of the Automobile Club.—11 illustrations..... 19780
The Management of Electric Vehicles.—By GEORGE T. HANCHETT..... 19785

IV. BOTANY AND HORTICULTURE.—The Flora of the Alps.—By Prof. ALFRED W. BENNETT..... 19778
Deutzia.—1 illustration..... 19777

V. CLIMATOLOGY.—The Climate of the Hawaiian Islands.—By ALBERT B. LYON, M.D..... 19789

VI. COMMERCE.—Trade Suggestions from United States Consuls.. 19780

VII. CYCLING.—Bicycling Without the Aid of Handle Bars..... 19787

VIII. ELECTRICITY.—Wood Seasoning by Electricity..... 19785

IX. GEOLOGY.—Transporting Power of the Wind..... 19790

X. ILLUMINANTS.—A New Acetylene Generator.—3 illustrations.. 19779

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Strength of Aluminum..... 19779

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Trade Receipts and Suggestions..... 19781
Miscellaneous Notes..... 19781
Selected Formulæ..... 19781

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